

PC MAGAZINE

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- Cable Modem, DSL, or Satellite: How to Choose?



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- RealPublisher Pro G2
- BackWeb 5.0
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THE INDEPENDENT GUIDE TO PERSONAL COMPUTING AND THE INTERNET

VOL.18 NO.8 APRIL 20, 1999

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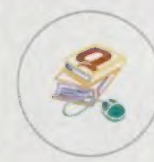
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The Future Web: Beyond Fast

Cost aside, which would you want more—the fastest processor on the planet or a T3 line directly connecting your PC to the Internet? A few years ago, most of us would have chosen the processor. Today, the vast majority would pick the faster Net connection. Speed is still important, and we can still talk about applications

that either don't exist yet or aren't fast enough because of bottlenecks on the PC. But for most of us, Internet access causes a bigger delay in our everyday computing.

I'm one of the lucky ones: I have had a cable modem at home for about a year and a half. The initial service was spotty; it was down a lot, and I had to keep a standard analog modem and account as a backup. But in recent months, my cable modem service has evolved into a fast, reliable connection.

As a result, it has made a huge difference in the way my family and I use the Internet. We can get to most Web sites very quickly, and we've been known to spend hours researching or just playing games online. I can download files very quickly. And I can use a virtual private network to connect to my e-mail and databases on our corporate servers as fast as I can from my office.

Today, I can listen to radio stations from around the world, and I'm starting to be able to get small but decent video windows on my machine. The latest versions of the players from both RealAudio and Microsoft have tremendously increased the quality of playback. But I expect the amount of audio and video content on the Web to grow hugely over the next few years. Eventually, you'll have far more choices on your Internet connection than on any of today's cable systems.

This kind of thinking is behind things like the merger of @Home and Excite, AT&T's merger with TCI, NBC's push into "portals" with its involvement in Snap, Disney and Infoseek forming the Go network, and so on. These companies and others like Yahoo! say that they are creating "broadband portals."

The theory is that fast connections will change the way everyone gets information. Today, almost 500,000 households have fast Internet access, whether by cable, DSL service, or satellite (see our story "Faster Web Connections"). And virtually everyone expects that number to grow dramatically

in the next few years. I certainly do.

But I'm worried that just a fast connection by itself won't change things. We need content, of course, and while on the surface it seems as though the new portals will help, that depends on how they are implemented. You may end up with a superfast connection to your cable company's portal but only regular connections to other sites. You could still get information from anywhere, but you might get high-quality audio and video only from your cable company. That goes against the grain. I want to be able to choose what information I get and have the same access to everything.

Even beyond content, we need changes in the way our machines work to take full advantage of all this speed. One benefit of a cable modem or DSL connection is that it is always on, but that doesn't do you any good if you still have to boot the machine or spend a while getting out of suspend mode. We need machines that are built to be on all the time, collecting the information we need. We also require an OS that is designed to be on constantly, and Windows 98 just isn't there yet.

Finally, we need applications that are designed for such an interface. A fast connection isn't enough; there will always be too much delay for very large files. So the answer is more tightly compressed files and images that can be created and put together on our machines, using their ever-increasing processing power. Intel touts this as one advantage of the Pentium III, and it's right, in theory. Now we need the applications.

Finally, we need a user interface that understands the kind of data we now have, where the information is coming from, and how we use it. That will require more intelligent processing both on Web sites and on our local machines, including everything from new search techniques to software agents.

Today, a fast Internet connection is a big step forward from an analog modem. But there's still a long way to go. **PC**

**We need changes
in the way our
PCs work to
take advantage
of fast new
connections.**



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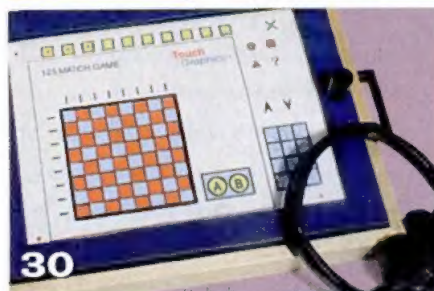
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Illustration: John Ueland; photography: John Wilkes (left), Thom O'Connor (right)



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Cable modems. Digital subscriber lines (DSLs). Satellite services. Find out which can connect your home or office to the Internet with the greatest speed and least hassle. *By Les Freed and M. David Stone*

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2D TECH BRIEF
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Hungry for the Web?

First you got Web access at the office. Then you got an account for your home PC. Now you can get Internet access at the fridge. And it's about time. After all, families spend much of their quality time in the kitchen, and that's exactly where Web retailers want to reach them. Two upcoming kitchen appliances can help make that happen.

Frigidaire Home Products and Dallas-based ICL have developed a prototype refrigerator stocked with

kitchen managers. This development can bring home shopping directly into the hands of the kitchen manager—the person responsible for running the heart of the home and for most weekly purchasing decisions.”

The fridge will undergo field trials this spring, after which the developers will decide whether it will go into production.

Meanwhile, Seattle-based CMi Worldwide has developed the CMi Advantage 2000, a PC/TV designed with grease-proof, shock-proof, washable components built to withstand the assaults of kitchen use. The system, which uses an Hitachi SH3 chip, is built on Spy-glass Device Mosaic browser technology

and combines Web access, cable-ready TV, and video and audio CD. The company plans to launch the Advantage.net Web portal,

Digital Kitchen Aid: This prototype Web fridge serves up mouthwatering digital goodies and links to online stores.

mouth-watering items, such as a 233-MHz microprocessor, 32MB of RAM, an Ethernet connection, a flat-panel touch screen, a bar-code scanner, and Microsoft Windows 95. Once the fridge is connected to a phone line or a home network that's connected to the Web, you can send orders to retailers, scan and purchase goods, pay bills, and send e-mail.

“Internet shopping is taking off, but until recently it was mostly the sale of books, CDs, and other leisure or entertainment items,” says Tony Evans, spokesman for Frigidaire Home Products. “Also, it focused on the PC or Web TV, which are not in the right place for people we call



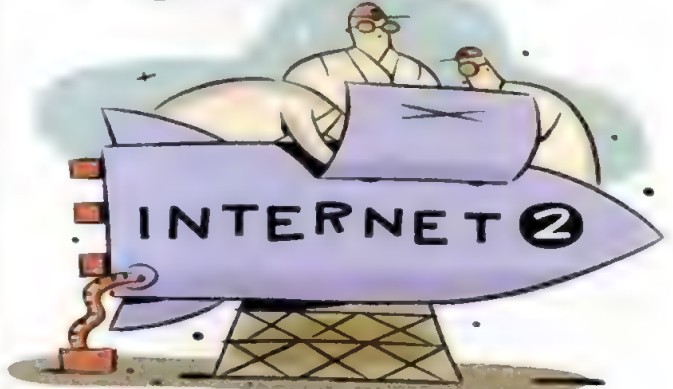
Space Saver: This TV/PC is designed as a custom, built-in kitchen appliance.

with channels covering family, health, home, lifestyle, cooking, chat, e-mail, and, of course, shopping. The appliance should be available this spring.

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percent of respondents to a recent PC Magazine Online poll told us they receive a new computer at work at least once a year. Others aren't so lucky. 29 percent said they get a new PC every two years, 28 percent said it takes three years before they get a new PC, and 26 percent told us they can't even remember how long they've had their current system for.

The GigaPop Net



What would you do with a really peppy Internet connection that's, say, 45,000 times faster than a 56-Kbps modem? University researchers around the country are dreaming up all sorts of applications that could use the extra bandwidth, and they're testing them out on Abilene, a super high-speed network that started operations in February.

Part of the Internet2 network linking major research universities around the country, Abilene, which runs on over 10,000 miles of fiber-optic lines, was put to work recently when doctors in Washington, D.C., participated in laparoscopic surgery performed on a patient in a hospital in Ohio. Live video was fed over Abilene's 2.4 gigabit-per-second lines.

Although use of Abilene is off limits to the public, 37 universities are now connected via aggregation points, called GigaPoPs, with over 70 universities expected to connect by the end of this year. Developed by the University Corporation for Advanced Internet Development, along with Qwest Communications, Cisco Systems, Nortel Networks, and Indiana University, Abilene is designed to run high-bandwidth applications such as telesurgery, digital libraries, and distance learning.

Net Worth, on the Fly

Do you get jittery if you're away from your stock quotes for very long? The new version of Netscape Communicator—Version 4.51—has a new feature called Quotes Anywhere, which lets you view stock quotes at any point during a Web session by typing the word *quote* followed by a ticker symbol. And if you've already entered your stock portfolio at Netscape's Netcenter portal site, you can type *my stocks* at any time to get updated quotes for all the stocks in your portfolio.

Netscape is betting that investors accustomed to visiting a portal or a financial site for quotes will want to get stock quotes no matter where they are in a surfing session.



Networked Appliances

Starting the washing machine from your cellular phone or setting the VCR from your office PC may sound farfetched now, but not for long. Fifteen technology companies recently joined together to support a specification that will link all sorts of digital devices to the Internet. If all goes as planned, you'll be able to manage energy utilization, control home appliances (such as washing machines, dishwashers, televisions, VCRs, and home-security systems), and make purchases over Web browsers built into a new generation of smart appliances.

The Java-based specification is designed so service providers and appliance manufacturers can work from common network-connectivity interfaces. Internet services can then be delivered to gateway servers running in the home.

Initial members include Alcatel, Cable & Wireless, EDF, Enron, Ericsson, IBM, Lucent, Motorola, NCI, Nortel, Oracle, Phillips, Sun, Sybase, and Toshiba. Question: Can you name the company notably absent from the group? Answer: Microsoft.



Web Photo Albums

The Web is a wonderful medium for sharing images with friends and family throughout the world, and several new sites can help you do this with style. PhotoLoft, in conjunction with Hewlett-Packard, has created a digital-imaging

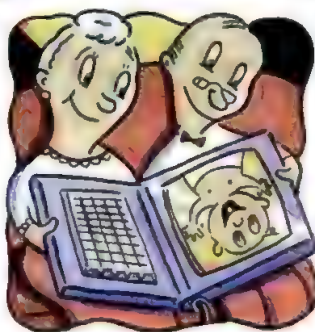
community site, which offers 20MB of storage space for free. The site uses HP's OpenPix technology to let you print high-resolution images directly from your browser. You'll also be able to order photo mugs, T-shirts, and photo gifts.

Live Picture is taking a similar approach to show off its Internet

imaging technology. The company's ZoomIt service lets you upload photos to the Web for free. The service then e-mails you a Web address that you can link to on your Web site. Like PhotoLoft images, images viewed on

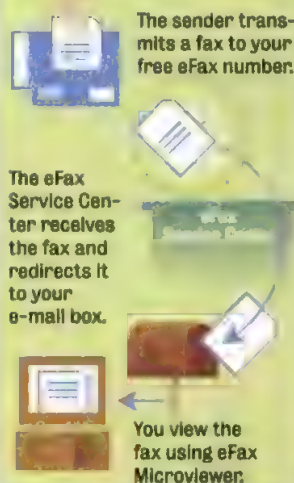
ZoomIt's site can be enlarged for finer detail. If you sell items on auction sites, ZoomIt is a great way to show off your wares.

Meanwhile, Ixla Limited is working on a portal specifically for digital photographers. PhotoHighway will give digital photo enthusiasts a place to find out the latest news, talk with others, and buy and sell equipment. The site will go live midyear.



Free Faxing

The paperless office may be a myth, but the faxless office isn't. It's not that people are faxing less, but developers are coming up with ways to let people receive faxes without buying an actual machine for that purpose. Start-up eFax has developed a technology that reroutes faxes sent to your personal fax machine—located at the eFax Service Center—to your e-mail box. Click on the e-mail message and the eFax Microviewer pops up so you can read your fax. Set up a free account with eFax at www.efax.com, and you'll get



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Norton System Works	Symantec
Microsoft Plus 98	Microsoft
VirusScan 4.0 Classic	Network Associates
pcAnywhere Host/Remote	Symantec
Microsoft Office Professional 97 Upgrade	Microsoft
Red Hat Linux Deluxe	Red Hat Software
Microsoft Office 97 Upgrade	Microsoft
WinFax PRO 9.0	Symantec

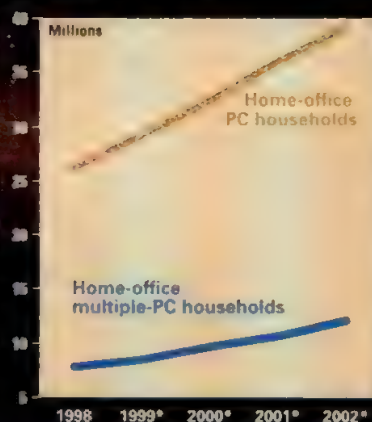
Source: PC Data, data for January 1999

Loans for Y2K

The Senate voted in early March to pass the Small Business Year 2000 Readiness Act, which calls for establishing a \$500 million loan program to assist small companies in fixing their Y2K problems. Small businesses are well behind larger ones in fixing Y2K problems, and the failure of a large number of small businesses due to Y2K problems would have a detrimental effect on the economy, according to the text. Set up by the Small Business Administration, the loans must be used for repairing systems, buying hardware and software, hiring consultants, or covering costs incurred due to suppliers' or customers' Y2K problems.

Multiplying Home PCs

The number of home-office households with multiple PCs is expected to hit 12.1 million by 2002, creating big opportunities for networking developers. The appeal of sharing a single Web-access account across multiple PCs will drive the widespread adoption of home networking, according to market research firm IDC.

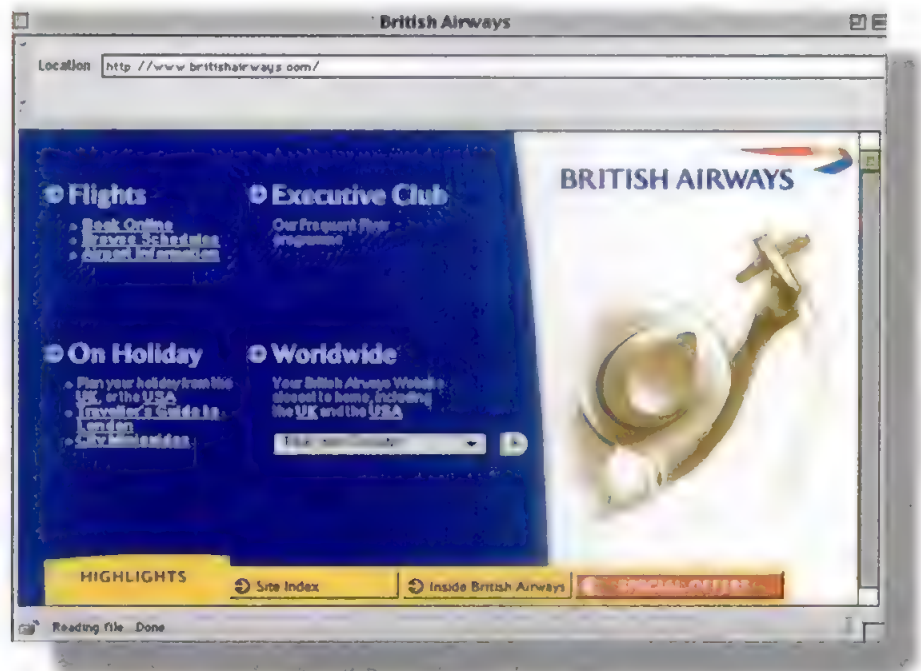


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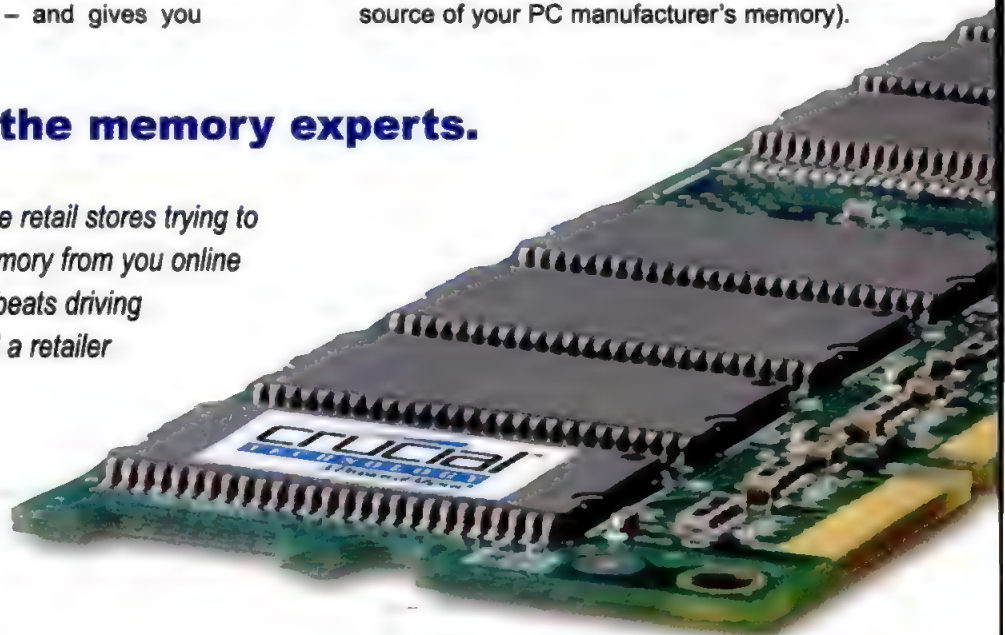
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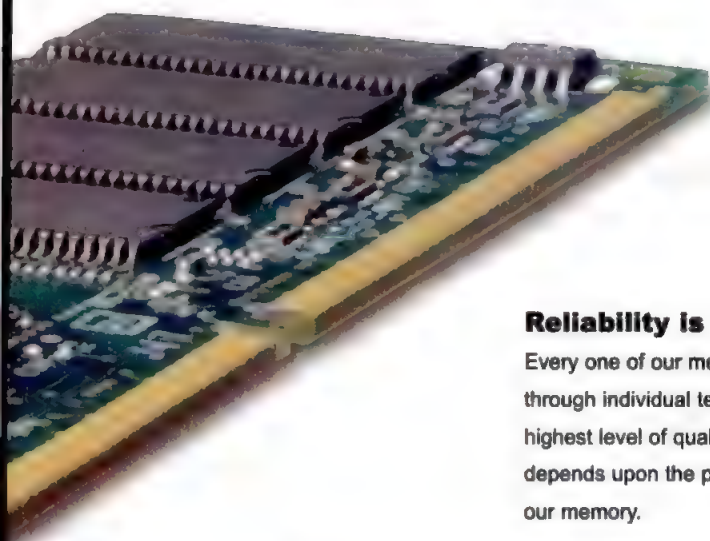
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Deskpro EN Series	\$62.69	113.99	199.49
Deskpro EP Series	\$62.69	113.99	199.49

Micron Electronics	32 MB	64 MB	128 MB
Millennia	\$62.69	113.99	218.49
Home MPC	\$106.38	189.98	379.96
Powerstation	\$106.38	189.98	379.96
ClientPro	\$62.69	113.99	218.49
Magnum	\$106.38	189.98	379.96

Gateway	32 MB	64 MB	128 MB
G Series	\$62.69	113.99	199.49
E Series	\$62.69	113.99	199.49
GP Series	\$62.69	113.99	199.49
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LETTERS

UP, UP, AND AWAY

I enjoyed your article on upgrading ("The Ultimate Upgrade Guide," March 9), but I think the instructions on how to install a motherboard (pages 128 and 129) may have left readers with the wrong impression. In my job as assistant systems administrator at the math department of a major university, I have replaced many motherboards in PCs. I have never needed to use force to remove a motherboard from a case.

The motherboard is held in place by one or two screws and several plastic anchors. The plastic anchors snap through holes in the motherboard and are slid into keyhole-shaped slots in the case. The screws keep the anchors from sliding out of the slots. When the screws have been removed, you can slide the motherboard sideways and lift it out of the case. The plastic anchors should be removed from the old motherboard for use on the new one. To remove them, you squeeze the flanges with needle-nose pliers and push them back through the holes in the motherboard. They can then be snapped into the holes on the new motherboard.

The anchors serve an important function: They support the motherboard during installation and removal of cards and memory modules. Here's another helpful hint; it may be easier to install your CPU and memory before putting the motherboard into the case.

CATHARINE ALVAREZ
via the Internet

I think you missed one major, simple, and cheap upgrade, applicable to thousands of your readers. Dell, Gateway, Micron, and so on made many standard machines with Pentium II chips. If you have one of the slower ones—say, 200 or 230 MHz—it is a simple matter to put in a 333-MHz PII chip. The setup screen shows the various CPU speeds with which the motherboard is designed to work. I did this last week to a Dell Dimension D233, in 10 minutes, at a cost of \$215, including a cooling fan. I immediately achieved an increase of nearly 50 percent in processing speed, with no problems whatsoever.

DAVID DUFFY
Weston, Connecticut

Under "Graphics Accelerators," you stated that a system with an AMD processor cannot use a graphics accelerator using an AGP bus and that "you'll need to stick with PCI." I have a 300-MHz AMD K6-2 with an AGP 3D Blaster graphics card. Perhaps you meant that systems shipped whole do not come with AGP buses, but there are a multitude of motherboards that support the AMD chip along with the AGP bus.

SHAUN C. EASLER
via the Internet

You're correct; unfortunately, we were not clear and specific enough. We should have written: "For starters, if your PC uses an old socket 7 motherboard that does not support AGP, with an AMD K-6 or a previous-generation Pentium chip, you'll need to stick with PCI." We apologize for any confusion.—Ed.

A KEY ISSUE

I think you are trivializing the dismal state of notebook keyboards when you vent a "pet peeve" about the Toshiba Satellite 4030CDT's Backspace key being inside the Home key ("Affordable Celeron Notebooks Deliver," First Looks, March 9, page 56).

How about doing a rational analysis of keyboard ergonomics? For example, the trend of imitating the IBM ThinkPad in separating the Arrow and Page keys is counterproductive. These eight cursor navigation keys are interrelated and should be adjacent, and they shouldn't require a full arm movement to use them. More important, why is it so rare to find a Ctrl key

With one of the slower Pentium IIs, it's simple to put in a 333-MHz PII chip.

for the right hand? On many notebooks, it is replaced by a redundant Windows key. Don't keyboard designers ever try to type Ctrl-F1? You either have to contort your left hand or lift your entire right arm to reach across the keyboard.

Everyone has personal preferences that are usually based on first experiences, but a true ergonomic keyboard design should allow common movements with minimum effort and stress. So much genius has gone into notebook computer design, but it hasn't reached the level of simple common sense for keyboard layout.

GARY BARBER
via the Internet

PROCESSOR TRANSCESSION

Your story "Intel IDs" (Pipeline, March 9) contains blatant errors. The statement "Intel also produced a utility to let users erase their ID numbers, but that wasn't enough for some privacy groups" is incorrect. Erasing implies that the processor serial number is permanently removed. The utility merely disables the processor serial number for the current CPU session. Power-cycling the computer or performing a hard reset will enable the processor serial number once again.

Another statement—"Responding to protests, Intel scaled back its effort and decided to make use of the IDs voluntary"—is incorrect as well. There is nothing voluntary about the chip having the processor serial number on by default.

JONATHAN ALLEN
via the Internet

It's true that Intel's utility, at the time of our story, was not designed to erase chip ID numbers. But the use of the serial numbers can be characterized as voluntary, because they can be disabled.—Ed.

BETTER ALL THE TIME

I want to commend you on your story "Make Your PC Work Better" (February 23). The tips on cleaning up the system tray were a tremendous help to me. I had a lot of programs running in the background, and the

only way I knew to get rid of them was to hit Ctrl-Alt-Del for each application, one at a time, every time I started up my computer. Thanks to your story, I no longer have to go through that aggravating process. Please keep printing these very helpful hints. That story alone paid for the magazine, as far as I'm concerned.

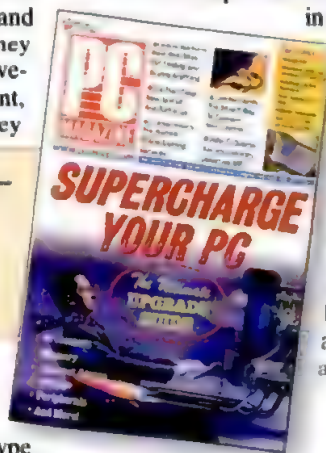
GRETCHEN A. ZEIGLER
via the Internet

One tip (in part) said to "make sure all your data files, customization files, Registry, and application configuration files are backed up...." Easy to say, but hard to do for those without the knowledge of where these files are and how to identify them.

JIM SWAYNE
via the Internet

You make a very good point. This might be the topic of a future article.—Ed.

As a system administrator, this is exactly the type of article that makes my subscription more than worthwhile. I realize that putting together this type of article is both time- and resource-intensive. Well, you've made many recent references to the impending release of a 200MB removable-media drive from Sony. Perhaps some of this ink could be spared for more informative articles such as "Make Your PC Work Better." As for the article itself, you repeated the reminder to back up the system properly a number of times. I think you should also have warned users not to set up Internet Explorer 4.0 as their shell. I've learned the hard way that set-



SO WHAT IF WE'RE THE SMALL FISH IN THE BIG POND.



Piranha, pi-ran'ya, n. A small, voracious freshwater fish that will attack any sized opponent, no matter how large.

We're not
the biggest,
so we have to
be the best.

So, we're not the biggest - that means we try harder...we have to be the best. By offering the perfect combination of service, quality and price, you get the best hardware solution possible. **Personalized Service:** You will be assigned a SAG Integration Specialist who will be your single point of contact from pre- to post-sale. It's their job to know your system inside and out. **100% True Customization:** Everybody claims to offer customized solutions, but our systems are truly built to order; you specify it, we build it. **Warranty & Support:** Our 3-year extensive warranty rivals the industry giants - plus you'll speak directly to our own on-staff tech advisors. **Leading Edge Technology:** We are known for being first-to-market with the latest technology. **Best Price:** Our prices continually beat our competition, see for yourself at sageelectronics.com. **Top Quality:** We only use top-of-the-line components. That's why we've won so many awards. Here are just a few.





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- Slots: 6 PCI, 1 ISA, 1 AGP
- 1000MHz 10/100 Ethernet
- AMI LVD Ultra2 RAID 6/5 Controller
- 49 Revolution II 32MB AGP 2X Video
- Sony 32X CD-ROM, Max
- Keyboard, Floppy, Mouse
- Full Tower 300 Watt

4351
ES Galaxy 52MB Dual Port Solution

- Intel Xeon PIII 500MHz Processor
- 512KB Cache, Expandable to 2 CPUs
- 128MB SDRAM Expandable to 2GB
- Slots: 16 PCI, 1 ISA, 1 AGP
- Sound & Ethernet 10/100 by Intel
- 11 Matrix G200 16MB AGP Video
- IBM 22GB 7200RPM IDE
- Sony 32X CD-ROM, Max
- Keyboard, Floppy, Mouse
- Full Tower 300 Watt

2747

- Intel Pentium III 400MHz
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- 64MB SDRAM Expandable to 2GB
- Slots: 15 PCI, 2 ISA, 1 AGP
- 10GB 5400RPM IDE Drive
- Sony CD Recorder, Rewritable
- Matrix G200 16MB AGP Video
- Keyboard, Floppy, Mouse
- Mid Tower Chassis

1700

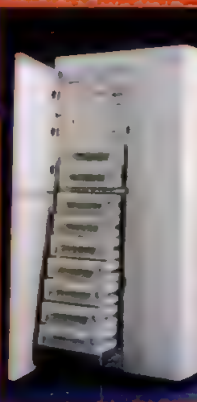
- Intel Pentium III 500MHz Processor
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- 128MB SDRAM
- Slots: 5 PCI, 2 ISA, 1 AGP, 11 AGP chipset
- IBM 10GB 7200RPM Ultra 33 Drive
- Sony DVD CD-ROM
- Soundblaster Live
- Subwoofer Speakers
- 16MB Diamond Viper 550 TNT Video
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- Mid Tower Chassis

2159
RGB Remov. LVD 10,000RPM Solution

- Celeron 333MHz w/ 28KB Cache
- 32MB SDRAM
- Slots: 3 PCI, 13 ISA, 1 shared, 1 AGP
- BX Chipset
- Integrated PCI Soundblaster
- B&W Audio Video
- AGP IDE Hard Drive (ST34321A)
- Sony 32X CD-ROM, Max
- Keyboard, Floppy, Mouse
- Inter Landesk Management Software
- Desktop Chassis

608
Celeron 433MHz Solution Available

SAMPLE SERVERS



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- 256MB ECC Memory, Expand to 4GB
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- Integrated Dual Ultra 2 LVD SCSI Controllers
- 3 Chn Ultra 2 LVD RAID Cont. w/ 64MB Cache
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2875
Tower Solutions Available

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- Matrix G200 8 MB AGP Video
- Integrated Intel 10/100 Ethernet
- 3 Channel LVD RAID 5 Cont. w/ 16MB Cache
- 32X CDROM, Max • Keyboard, Floppy
- 13 Bay Tower Chassis 400 Watt Redundant, Hot Swap Power

7185
3 Bay Rackmount Solution

- Intel Pentium III 500MHz Processor
- 512KB Cache, Expandable to 2 CPUs
- 128MB ECC Memory, Expandable to 1GB
- Slots: 15 PCI, 2 ISA, 1 AGP, 11 AGP
- Integrated Adaptor Ultra2 LVD SCSI
- 32X CDROM, Max • Keyboard, Floppy
- Sony 32X CD-ROM, Max
- Keyboard, Floppy, Mouse
- Full Tower 300 Watt

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SAMPLE RAID SUBSYSTEMS



STC 10 DAY

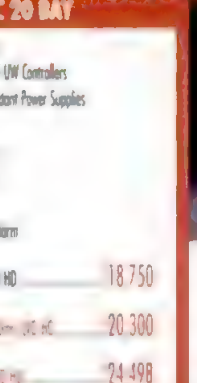
- 2 Channel RAID LVD Ultra2 Controller
- 10 Hot Swappable Drive Bays
- Redundant Power Supplies
- 16MB Cache
- Internal Temperature Status
- Power Supply Status
- Cooling Fan Status
- Visual and Audible Alarm

Q 13 36GB 7200RPM LVD HD 8825
Q 1 18GB 10000RPM LVD HD 7928
Q 1 36GB 10000RPM LVD HD 6458

STC 20 DAY

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- Q 12/14 Channel RAID 5 LVD Controllers
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- 128MB of Cache
- Internal Temperature Status
- Power Supply Status
- Cooling Fan Status
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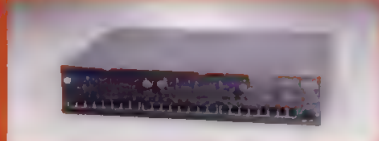
Q 18 36GB 10000RPM LVD HD 24,498



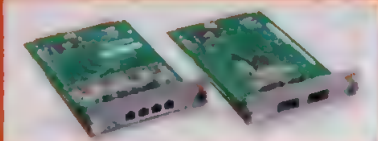
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ting users' systems this way is sure to double my work load. Thanks for a nice issue.

MICHAEL COCOROCHIO
via the Internet

MUSIC FOR A SONG

Usually, I get a laugh, followed by a nod of recognition, when I read John C. Dvorak's column. But the tone of his March 9 column, "MP3 Spells Disaster," implies that he doesn't give a hoot about copyright. If he were the direct beneficiary of the copyright protection afforded by law, he might whistle a different tune. Maybe the record companies are giant behemoths that have destroyed the music listening (and buying) experience for millions by cutting out production of singles on a regular basis. But there are other parts of the equation besides record companies and musicians. Take the songwriters, who receive 7.75 cents per copy sold when their songs are legally distributed. I should note that the music industry has taken some positive steps with MP3, with new sites popping up that will charge 99 cents per song (about what a 45-rpm single used to cost) and automatically tally up the mechanical royalties. The record companies have no choice; otherwise, their sales will plummet once the Internet reaches everyone. Let's not forget about the other links in the chain when we consider blasting the record companies. It takes more than a fat cat and a guitar player to bring music to the masses.

CHARLIE O'REILLY
via the Internet

NOT TOO LOGICAL

Perhaps in the photo showing IBM manager Robert Wisniewski holding a medical display captioned "The Remarkable Roentgen" (Trends, March 9, page 35), the display should be retitled "The Remarkable Robert." He's holding

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that we cannot answer letters individually. To send submissions for PC Solutions, please see the sidebar "How to Contact Us" on the last page of that column.

Corrections and Amplifications

In "Make Your PC Work Better" (February 23), in the "Editors' Hot Links" (page 115), two URLs were misprinted: www.zdnet.com/zdhelp/win_help/win_help.html should be www.zdnet.com/zdhelp/win_help/win_help.html, and www.support.microsoft.com should be <http://support.microsoft.com>.

In "Are You Ready For Biometrics?" (February 23), we incorrectly stated that the Compaq Fingerprint Identification Technology requires users to enter a password in addition to using the fingerprint scanner. In fact, you can set the software to accept just a fingerprint to gain access. We also complained about the wiring setup, in which the product occupies your parallel port with no pass-through for a printer or other device. Compaq reports that its upcoming USB version will eliminate this problem.

In "Pentium III Hits 500" (March 23), in the review of the Gateway G8-500, we mistakenly stated that the system includes a Phillips recordable-CD drive. It actually contains a Phillips rewritable (CD-RW) drive.

the display in front of his chest, I assume to simulate an office fluoroscope effect. But the chest X ray on the display is backward, showing his heart and aorta on his right side! Although I've seen such people, with complete *situs inversus*—genuine mirror-image reversal of all internal organs—they are very rare, perhaps a few per million. Maybe an X ray of Mr. Spock would have prevented the problem; Vulcans are known to have total body symmetry.

SCOT SILVERSTEIN
Wilmington, Delaware

WHY 2K?

Jake Kirchner's column "Y2K Without Fear" (March 9) blithely glosses over the most serious problem in computing today. I'm talking about the general shoddiness and poor design of computer software. Kirchner writes: "You hear a lot of people warning that the Y2K bug will make our computers unreliable. Since when have computers been reliable anyway? Mine are full of bugs. I can handle one more." Please! There is no reason for your publication to acquiesce to lousy software quality. *PC Magazine* typically provides lots of data comparing features and performance, especially in the hardware realm, where things are easily quantified. But it is rare indeed that your reviews even mention the obvious user-interface defects that are easy to find in the course of minimal product testing, let alone take a strong editorial stance against them. The Second Looks column is but a tiny step in the right direction; you could do so much more to improve software quality. Or should we conclude that *PC Magazine* is now "The Independent Apologist for Computing and the Internet"?

MICHAEL BOLTON
Los Angeles, California

Thank you, Jake Kirchner, for reminding us that we have nothing to fear but fear itself. I only hope we can get those running for the caves in New Mexico to slow down and listen to you. Well done!

MARK BRYANT
via the Internet

TILE STYLE

I agree with all Bill Howard's points in his column titled "Twenty Questions" (January 19)

except for one. He states that there is no way to have two different windows take up equal space on the screen (horizontally or vertically) other than by manually resizing and moving the windows. Well, there is a way in Windows 95 and 98. Simply minimize all windows except those you would like to keep on the screen, then right-click on an unused portion of the Windows taskbar and select either Tile Horizontally or Tile Vertically.

FRANK TROIANI
via the Internet

POINT OF REVIEW

On more than one occasion, I've purchased a product recommended in one of your reviews, only to find it was unstable, unavailable, or not performing up to your findings in some way. The simplest way to prevent this is to establish a policy whereby you review only products that are obtained through a retail purchase. This would prevent vendors from cheating or from giving you products that are actually months away from shipping. You would also be providing your customers with much more accurate information with which to make their buying decisions. I realize that *PC Magazine* reviews thousands upon thousands of products a year, and such a policy could prove expensive.

Perhaps instead of requesting the product from the vendor, you could request a voucher with which to purchase the product in return for its inclusion in your reviews. Your tests and reviews are very important to the industry. These measures would force vendors to compete honestly and would ultimately lead to better products for all of us.

GARY CRISTOFOLI
via the Internet

STICKY SITUATION

Thanks for the warning about AdGateway ("Sticky Ads," Pipeline, February 23). The interruptions generated by this program will be as eagerly anticipated as telemarketers' calls during my evening meal. I can foresee at least two responses: new features in antivirus software that will detect and attempt to disable the program, and successful efforts by shareware developers to charge a fee to disable it.

TOM YOEMANS
via the Internet



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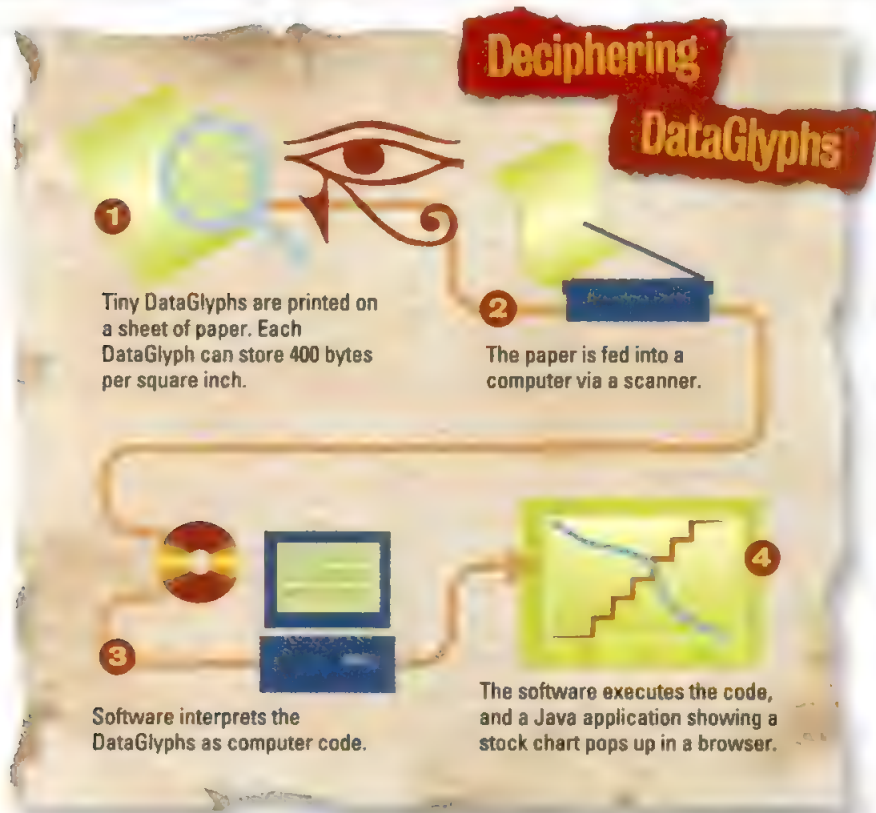
The Computer Inside.™

What's a DataGlyph?

Xerox is focusing on an ancient kind of media: paper.

There are few places in Silicon Valley possessed of more lore than Xerox's Palo Alto Research Center (PARC). Located in the rolling hills near Stanford University, PARC is where the graphical user interface took shape and where the mouse was born. On a recent visit by *PC Magazine* to Xerox PARC, editors got an imagination-stretching look at

DataGlyphs are designed for encoding computer-readable data onto paper documents. The codes on the paper, which look like tiny diagonal crosshatches when viewed close up, can be scanned into a PC and translated automatically into code a computer can read. The code might represent a word-processing file, authentication information corresponding to an individual for security



some of the technologies now being researched there.

According to John Seely Brown, chief scientist at Xerox and the director of PARC, one of the most promising media types for new computing applications is paper. Yes, you read that right: *paper*. Xerox is developing (in addition to many other technologies) DataGlyphs, a technology that will make paper documents smarter.

purposes, or even a JavaBean designed to get a computer to bring up, say, a Java-based charting application. A square block of DataGlyphs the size of a postage stamp can hold the entire text of the Gettysburg Address.

Why would people want to encode digital data on plain old paper? According to Brown, it's important partly because the paperless office is a myth. In fact, paper-based communication has kept pace with digital information.

He says that "self-authenticating documents" and documents of all kinds that are "partially digital, partially physical" have broad implications for future applications.

BAD BRAZILIAN CHECKS

Xerox has found many applications for DataGlyphs so far and has developed middleware software—called Paperware—for using DataGlyphs in corporate environments. One DataGlyph application is in use in Brazil, where checks rather than credit cards or cash are a very popular form of currency. The country also has rampant check fraud. Many Brazilian banks are using Xerox's DataGlyphs encoded on checks to prevent the use of counterfeit checks. A retailer or bank can scan a check and, using a computer that reads the code embedded in the check's DataGlyph block, ascertain whether it is authentic.

In a security card application, standard plastic cards can be replaced by paper cards containing a photo of an employee along with DataGlyphs to authenticate the employee for, say, access to a restricted area. Such a security card can be produced for about a penny, according to Xerox scientists.

HTTP STAPLES FOR PETS

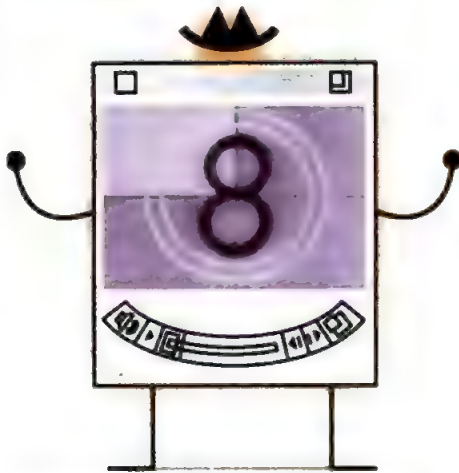
The more general concept of physical objects other than paper with links to the digital world is also a fertile area for research at Xerox PARC, according to Brown. For example, during *PC Magazine's* visit to PARC, he showed a small staple developed by the U.S. Department of Agriculture that emits radio frequencies. The radio frequencies can be scanned and understood by a computer to correspond to, for example, a record in a database that might be stored on a Web site. Brown called it an "HTTP staple."

Who would want such a thing? According to Brown, many cats and dogs in Silicon Valley have the staples embedded under their skin as "digital brands." Veterinarians in Silicon Valley can scan stray animals for the presence of such a staple. When the staple is detected by a scanner and a computer, it brings up a Web page that has the pet owner's information. Xerox is looking at how to use HTTP staples in scenarios involving documents. Says Brown, "It's all about questioning the border between the physical and virtual worlds."—*Sebastian Rupley*



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Business TV



The availability of digital video cameras and fast connections is making video on the Web more commonplace. And it's playing a larger role than ever on corporate intranets, as production, editing, and delivery tools sweep onto the scene.

Today, companies can set up full-fledged Web video studios, deliver corporate videos efficiently over intranets, and set up vast video databases capable of searching through images. Although the possibilities are more limited for home users connected at 28.8 Kbps, developers are also making it easier for personal Web sites to serve up video.

Aiming squarely at the corporate market, start-up SightPath has developed a hardware and software combination that lets businesses create private TV-quality video networks over their intranets. SightPath's distribution architecture relies on the network-connected SightPath Internet Media Appliance, which downloads, stores, and *microcasts* multiple video streams to the browsers of individuals located in far-flung locations on the network. SightPath Studio software is designed to manage the efficient distribution of video to the caching appliances on the wide-area network without affecting the performance of other appliances.

Also targeting corporate customers, Islip Media has created MediaSite.net, which offers search, preview, and purchase of online video and audio. The site provides stock footage as well as news and training materials. You can download the free MediaSite Logger tool for cataloging video and MediaSite WebFinder for video search and retrieval.

For consumers, RealNetworks and GeoCities have teamed up to let home users with Internet connections as slow as 28.8 Kbps add video clips to their GeoCities Web sites, using server software from RealNetworks.

—Sharon Nash



Tough Testing with the AMD-K6-III



While testing the AMD-K6-III chip for this issue's First Looks story, we found that rating the merits of a new CPU can be a difficult business. Judging from the performance of two new K6-III PCs running our Winstone and WinBench tests, we'd say the chip is comparable to the Intel Pentium III processor in many respects—and about \$200 cheaper—but anomalies abound.

The first machine to arrive at PC Magazine Labs was a home gaming system from Cybermax Computer, equipped with the 400-MHz K6-III. The Cybermax Enthusiast had a 5,400-rpm hard disk and a 3Dfx Voodoo Banshee graphics card—parts ostensibly less adept than the 7,200-rpm hard disks and nVidia RIVA TNT-based graphics cards used by the machines we reviewed in our inaugural 500-MHz Pentium III roundup ("Pentium III Hits 500," March 23, 1999). The system still managed to achieve a Winstone score of 24.5. This was within 2 percent of the average score of the Pentium III PCs we tested. We figured that if we were to upgrade the machine's disk and graphics card, the 400-MHz K6-III would surely outperform the 500-MHz Pentium III machines.

Yet this was not the case. Equipped with a 7,200-rpm disk and a TNT-based card, the CyberMax improved its Disk and Graphics WinMark scores, but its Winstone score slipped to 23.2. We reinstalled the 5,400-rpm disk to isolate the problem and, inexplicably, saw the Winstone score leap back up. Several 5,400-rpm drives are capable of outperforming disks with faster rotational speeds, but this one scored lower on

our Disk WinMark tests than the 7,200-rpm model. AMD was flummoxed by this paradox, as we still are.

Subsequently, we received the Compaq Presario 5600s, which included a 450-MHz K6-III. In the light of the strong performance of AMD's 400-MHz chip, we assumed the faster model would beat the Pentium III. It didn't. Though equipped with a TNT-based card, a 7,200-rpm drive, and a larger L3 cache, it achieved a Winstone score of only 23.4. AMD clued us in to a bug in the system's chip set. Whereas the CyberMax uses the Ali Aladdin 5 chip set, the Compaq uses the Via MVP3 chip set, which according to AMD has bus-mastering deficiencies.

During FPU WinMark testing, the K6-III failed to perform as well as the Pentium III on floating-point calculations. Both the Compaq and the Cybermax scored roughly 40 percent less than the average Pentium III PC.

The performance of a graphics card varies significantly depending on the proficiency of the driver. After several tries, we finally loaded

the correct driver

for the Compaq,

and the machine

scored a respectable 570

on our 3D WinMark tests.

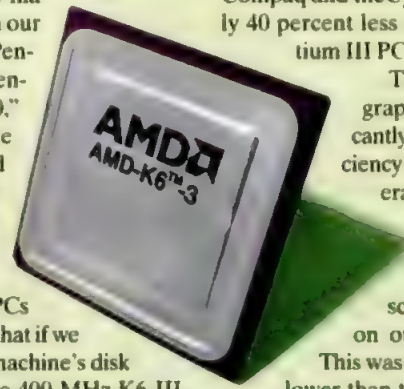
This was still roughly 17 percent

lower than the score posted by the

average Pentium III, though.

It appears that Intel is still the performance leader in the mainstream CPU market—if only by a hair. Yet the anomalies we found in testing proved one thing conclusively: A PC's performance depends on much more than its processor.—Cade Metz

▼ The AMD K6-III proved a formidable rival to the Pentium III when running 2-D business software, but it failed to perform as well during 3-D geometry processing.



2D BUSINESS WINSTONE 99

Compaq Presario (K6-III/450)	23.4	
Cybermax Enthusiast (K6-III/450)	24.5	
Average Pentium III/500*	24.7	

BETTER ►

3D 3D WINMARK 99

Compaq Presario (K6-III/450)	570	
Cybermax Enthusiast (K6-III/450)	581	
Average Pentium III/500*	685	

* PC Magazine, March 23, 1999

BETTER ►

ACCESSIBILITY

Extrasensory Computing

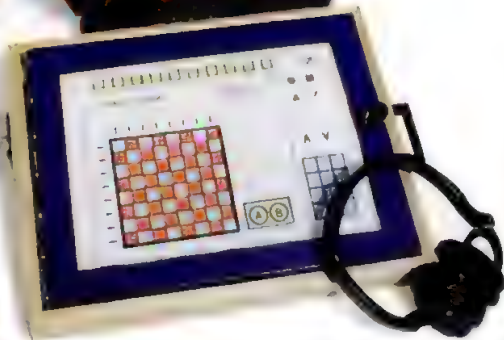
When technology advances sweep the education and business markets, the visually impaired are left to wait for product developers to build costly adaptive solutions. But that's changing.

To speed the development of adaptive Java apps, IBM recently released its Self-Voicing Kit, which lets users add, expand, or customize Java apps with accessibility features for the disabled, such as an audio user interface that reads aloud what's on the computer screen. The kit is available for free download on IBM's alphaWorks Web site. IBM has also announced a talking Web browser called Home Page Reader.

One new company, Touch Graphics, has designed the Talking Tactile Tablet, a low-cost input device that uses a touch screen overlaid with a removable "tactile dia-

gram"—a plastic overlay with raised shapes representing on/off and back/forward buttons and so on. Each application has a corresponding tactile diagram. A blind or visually impaired user slips a tactile diagram onto the touch screen, and audio messages provide instructions for using the application. The tablet can also help the visually impaired work with spreadsheets and spatial math.

Meanwhile, a new Purdue University Web site called TAEVIS Online is offering an electronic library with more than 2,500 tactile diagrams covering college-level course material including chemical structures and biological drawings. *Capsule paper* lets users create tactile graphics from Adobe Acrobat documents by using laser printers and a heating unit. An image is copied onto the capsule



PLEASE TOUCH: The Talking Tactile Tablet uses a tactile diagram overlaid on a touch screen as a graphical interface for the visually impaired.

paper, which is then heated to make the areas covered with toner expand and rise.

Microsoft is also targeting the adaptive-products market with an accessibility site (located at www.microsoft.com/enable) that includes information on where to obtain Microsoft products adapted for the disabled—Sharon Nash

Microsoft Is Bloodied but Still on Its Feet

Now that the U.S. Justice Department's antitrust trial against Microsoft is sputtering to an end, it's a good time to pause and take stock of what this legislative donnybrook has produced.

After a six-week trial recess, both sides are now starting to present their rebuttal witnesses and arguments, which means the trial will soon end. It's too early, of course, to say with assurance how the judge will rule, but this much is clear: Microsoft and its executives have been thoroughly humiliated in the process. The government has ripped apart the testimony of just about every Microsoft witness, frequently using their own subpoenaed e-mails to contradict their prepared materials and in-court statements.

By heaping public ridicule on the Microsoft contingent, the Justice litigators have done an admirable job of making the Microsoft corporate hierarchy look like incompetent con artists at best—and liars and thieves at worst. It's been one sorry spectacle for the proud company, which entered the trial with its long accustomed swagger but has spent most of the process on feeble spin-control efforts outside the courtroom.

The Justice presentation has been so overwhelming that many observers are already speculating on what remedies the government will seek when it wins the case, as many believe it will. Will Microsoft be broken into several independent companies? Will the government insist on overseeing future development of Windows? Will every Microsoft relationship with computer makers be

subject to daily Justice Department scrutiny?

Even if the government does win this case, there will be appeals. If the suit eventually proceeds to the Supreme Court, the outcome is anybody's guess.

So this case is far from over. More important, despite the public thrashing suffered by Microsoft in the Washington courtroom, it's not clear to me that the government has proved its case. There really hasn't been any smoking gun introduced into evidence. The embarrassing e-mails for the most part have been just that—embarrassing. They really haven't shown anything beyond what we already knew: Microsoft fights with no holds barred.

The company throws its weight around whenever it can, and its leaders are as paranoid about potential competition as they are arrogant about their position in the marketplace. But has Microsoft broken the law in trying to force PC makers to stick with Windows and to refuse the use of Netscape browsers? Have Microsoft tactics in competing with the likes of Apple, Netscape, and Sun violated antitrust statutes? After months of testimony, the government's case is no stronger than it was prior to the opening of the trial. The government has managed to do little more than bring to light many more instances of the kind of Microsoft business dealings that everyone in the personal computing industry was already well aware of.

Microsoft has accused the government's lawyers of resorting to cheap courtroom tricks and legal theatrics. That characterization is pretty much on target. That does not necessarily mean the government's arguments are wrong, but that doesn't mean they're right, either. If the worst injury to Microsoft is the public humiliation it has experienced so far, then the company will limp away satisfied. So far it suffered no more than a figurative bloody nose. Unless the persistent settlement rumors prove true, this fight has a number of rounds left.



Jake Kirchner



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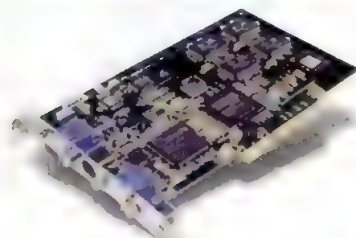
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DIGITAL CAMERAS

2-Megapixel Preview: Fujifilm and Nikon

With the imminent release of half a dozen 2-megapixel digital cameras, we've finally reached the long anticipated point at which digital cameras can produce images of the quality equal to traditional point-and-shoot film cameras. This new generation offers significantly higher-resolution images, better colors, faster shooting times, and a host of advanced features. Although the first 2-megapixel cameras are scheduled to hit the market in April and May, we took a sneak preview of a pair of pre-production models—the Fujifilm MX-2700 (\$799 list) and Nikon CoolPix 950 (\$995 list).

Each model improves on its predecessor—the MX-700 and the CoolPix 900—in a number of practical ways: faster power up times, larger memory buffers, truer-to-life color, easier-to-use

James Bondian appearance.

Unlike the previous model—the MX-700—the MX-2700 is designed so that you can't insert the SmartMedia memory card in backwards. Though the auto-focus lens has a fixed focal length, it comes with a 2.5X digital zoom. A metal shutter automatically closes when the lens isn't in use. The high-capacity rechargeable lithium ion battery is good for several hundred shots, depending on how often you use the built-in flash and LCD viewfinder.

The MX-2700 is neither for serious photographers nor for professionals. To squeeze everything into such a small package, the MX-2700 had to forgo some features such as an optical zoom lens, a focusable diopter on the optical viewfinder, and a sustained burst mode.

And though setting a manual white balance and exposure compensation is possible, there are no manual f-stops

FUJIFILM DX-2700

www.fujifilm.com

- \$799 list
- 8.5 ounces
- Top resolution: 1,800-by-1,200
- CCD pixels: 2.3 million
- Memory: 8MB

wide-angle, teleconverter, and fisheye lenses that screw onto the zoom lens. You can select among three resolutions and three JPEG compression modes and can save uncompressed images as TIFF files.

You can use the camera in a variety of modes, including shutter or aperture priority. The matrix metering and continuous, manual, or automatic focus modes ensure perfectly exposed, accurate images, even in very low light without flash.

Navigating through the modes and menus quickly becomes second nature.

All controls are clearly marked and quite accessible.

You can use the camera one-handed, though it's not nearly as light and convenient as the MX-2700. One particularly useful mode is the Best-Shot Selector, which captures five images in 1.5 seconds, instantly compares them to an internal antijitter profile, and automatically saves the best, sharpest image. The CoolPix 950's flash is accurate down to inches, and the camera is equipped with a PC plug for attaching studio strobes. Its large buffer permits single-, continuous-, and high-speed capture modes, and up to two frames-per-second in the highest-resolution mode.

One significant difference between the CoolPix 950 and MX-2700 is the choice of memory cards. The Fujifilm unit uses SmartMedia memory cards, of which the highest density is 32MB. The Nikon camera uses CompactFlash cards, which go up to 96MB and will shortly be available in 160MB. Both cameras feature standard serial ports but not faster USB interfaces. Transferring images from a high-density memory card via a serial port could easily take an hour or more, so we strongly suggest that you buy PC Card drives and adapters.—Daniel Grotta and Sally Wiener Grotta

NIKON COOLPIX 950

www.nikon.com

- \$995 list
- 12.3 ounces
- Top resolution: 1,800-by-1,200
- CCD pixels: 2.11 million
- Memory: 8MB

controls, and better power management. Their most significant enhancement is the greater density of the CCD or charge-coupled device, the photosensitive chip that captures images. Over 2 megapixels translates into superb images of 5MB to 6.5MB.

FUJIFILM MX-2700: IT'S JAMES BONDIAN

The MX-2700 and CoolPix 950 are designed to appeal to very different users. The MX-2700 will invariably turn heads when you pull it out and start shooting. Its slim, rounded, brushed-steel case weighs only half a pound, and the unit is small enough to slip into a shirt pocket or purse. It's best operated one-handed; all controls are accessible without having to take your eye away from the viewfinder. The futuristic mode wheel—a round toggle switch with red flashing lights on the back (to indicate power-up and when the just-captured image is being saved)—and Chiclet-size control panel give this camera a

or shutter speeds. The built-in flash doesn't automatically adjust in macro mode nor is there a separate PC connector for attaching auxiliary strobes.

Though these limitations might frustrate serious photographers, the MX-2700 is the digital camera to use whenever it's not convenient to carry a regular-size camera but you still want to record high-quality images.

NIKON COOLPIX 950: ALL BUSINESS

Twice the size and 4 ounces heavier than the MX-2700, the Nikon CoolPix 950 is all business, with numerous features that will satisfy serious photographers. It has a high-speed 3X auto-focus lens that you can extend with a 2.5X digital zoom. Nikon offers optional

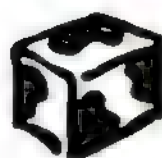


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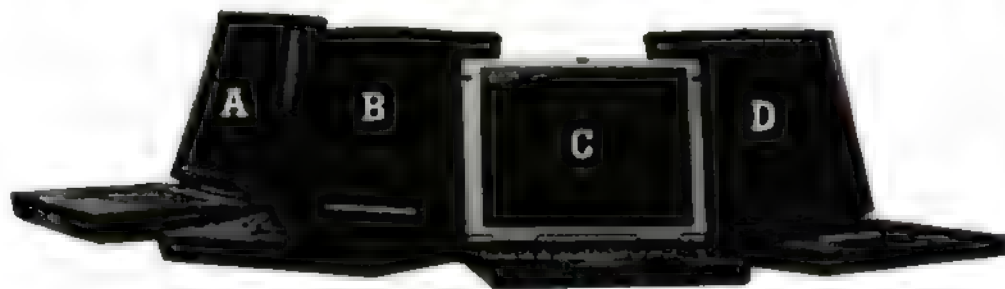
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Starting a Small Business

By David Lidsky

The number of small businesses in the U.S. has increased 57 percent since 1982, according to the Small Business Administration. When you needed advice in the past, maybe you had to ask your Uncle Bob, who ran the hardware store in your hometown, or call in to a talk show on A.M. radio. With the advent of the Internet, it's easier than ever for a new business to get around some of the tough start-up hurdles. You can get advice, access capital, and even communicate and work with colleagues and customers without having a physical office. Here are a number of ways to help you launch your small business.

Get Started

➤ The Web is rich with resources for budding entrepreneurs looking to launch and manage a small business. A good place to begin is **Yahoo! Small Business** (<http://smallbusiness.yahoo.com>), where you'll find links to articles from business magazines and lists of sites to help you get information. The **Small Business Administration's** site (www.sbaonline.sba.gov) offers lots of helpful advice for starting a business, getting financing, understanding the legal issues, and more, although much of it is written dryly. You'll find more straightforward advice at **American Express Small Business Exchange** (www.americanexpress.com/smallbusiness). The site is most notable for its tips and worksheets on building an effective business plan and its Expert Advice section, where you can submit a question about anything from management to marketing and get a response within a week.

Find Funding

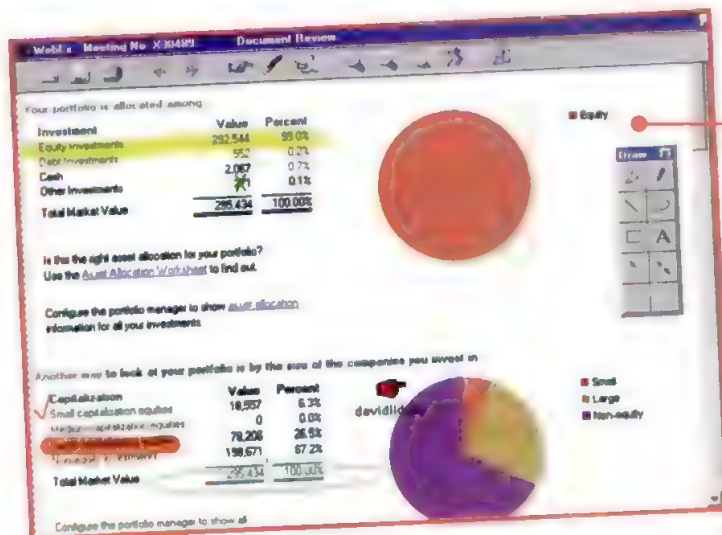
➤ You can only borrow so much from family and friends before you need some real money to run your business. **Quicken Business CashFinder** (www.cashfinder.com) can help match up your business's needs with one of its partner lenders. The process is straightforward and takes just a few minutes: Answer a few simple questions (how long you've been around, how much money you want, and so on) and the site tries to find the most appropriate financial service for you (credit card, lease, or line of credit, among others). Download the CashFinder program and you can fill out one form for up to three applications and then mail or fax it to lenders. **Garage.com** (www.garage.com) tries to pair up would-be high-tech entrepreneurs

with seed financing from noted investors, venture capitalists, and corporations. The selection process is rigorous, including approval by a selection committee, submission of your business plan, and a face-to-face or phone conference. **The Elevator** (www.thelevator.com) is similar (and also free) but targets more than just high-tech start-ups

to see who's logged into the site, chat or teleconference with them, and control a remote computer. NVO is slicker than any of the other Web-based virtual offices, but it's \$19.95 per month after the first free month. As a functional and low-cost way for a company to communicate, Yahoo! has created a small business version of its popular Yahoo! Clubs called **Yahoo! Connected Office** (<http://connected.clubs.yahoo.com/office>). You get a lot of the same features for free that you pay for with NVO, but it's neither as professional-looking nor as secure. If you need to make a presentation to a potential remote customer or give a tour of your Web site, check out the virtual conference space offered at **WebEx.com** (www.webex.com). A free service, WebEx lets you share applications, documents, and presentations with up to five other people.

Keep in Touch with Customers

➤ **eGroups** (www.egroups.com), **ONelist** (www.onelist.com), and **Topica** (www.topica.com) are all free services that let you start a mailing



WebEx lets you share and mark up documents with colleagues on the Web in its virtual meeting space.

and seed money. Make your 150-word pitch, then wait 24 hours to hear if someone wants to see a more complete business plan.

Manage a Virtual Team

➤ Communicating within your company or with outside business partners or customers can all be handled online at little or no cost. **Netopia Virtual Office** (<http://nvo.netopia.com>) will build you a prefab yet easily customizable site that includes a shared calendar, message boards, and a file repository. Download the plug-in software and you can check

list and keep in touch with customers either through e-mail, the site, or both. You can set up an announcement list as well as moderated or free-form discussions. ONelist and eGroups let you remove the advertisement at the bottom of all e-mail sent for \$4.95 per month, making you look more professional. ONelist allows only 250 users in an e-mail list; Topica lets you have 500. Topica offers the most sophisticated interface and management options, letting you see delivery errors, and is the only service of the three that lets you bulk import an e-mail list from a file. **PC**

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classes, seminars and self-paced tutorials on the hottest topics in computing and business today. Accessible twenty-four hours a day, seven days a week, a one-year subscription to Micron University comes standard with every new Micron desktop or portable system. This revolutionary program can drastically decrease training costs while empowering users of all skill levels and disciplines. It's just one more way that Micron is building not only powerful systems, but powerful users as well.



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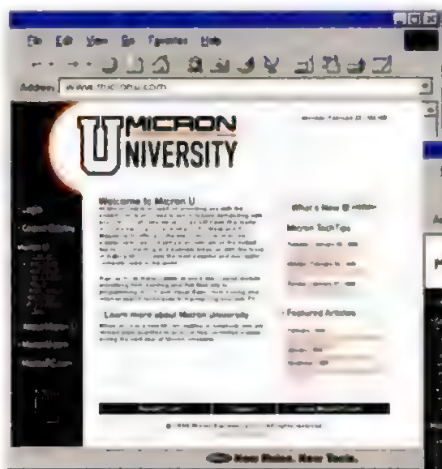
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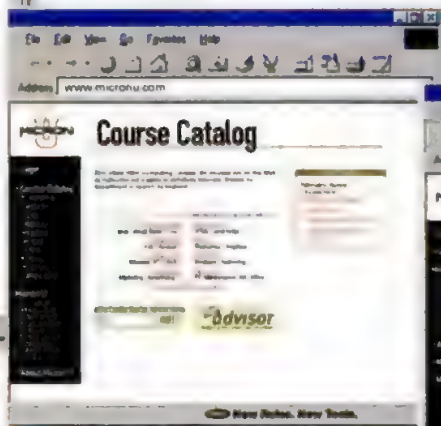
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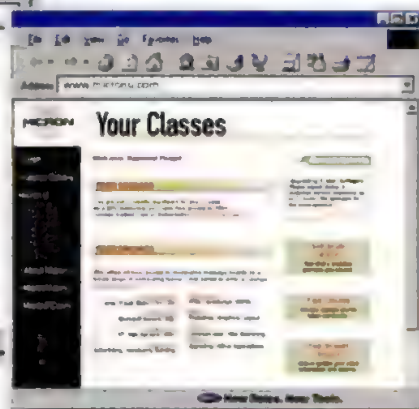
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IE5: The Final Cut

The completed version of Microsoft Internet Explorer 5 makes the grade with a slew of new features and usability tweaks.

By Jim Lynch

In mid-March, Microsoft released the final version of Internet Explorer 5, packed with a rich array of never-before-seen features and usability improvements. There's something for just about everyone in IE5, from users and administrators to content providers and developers. In this release, Microsoft has concentrated most on giving people the tools they need to make Web surfing faster and easier.

EASY SETUP AND HELP

Microsoft has streamlined IE5's installation procedure into components. You can now install the absolute bare minimum of features necessary for the browser to function, with the option to install others automatically as you need them.

There's also a new Go button next to the URL address box, geared toward making IE5 easier for novices to use. This will help those who don't know to hit Enter after typing in a URL.

Microsoft has also added information to the dreaded File Not Found error messages. When you try to load a page that doesn't exist, or if the page can't connect properly, IE5 will display a list of possible problems, such as a network error or spelling mistake. IE5 will also suggest hitting Refresh or using the Back button to try loading the page again.

SEARCHING MADE EASY

Microsoft has continued to refine Internet Explorer's search capabilities. You can now search

for a Web page, e-mail address, or street address. IE5 does this in part by using AutoSearch, a feature introduced in IE4. When you type a keyword into the URL address box, IE5

This is reflected in the browser's search capabilities but also in its handling of URLs and forms. IE5 automatically displays a drop-down list of previous entries when you start to type a URL into the address bar. You can then simply select the appropriate site and skip having to enter the URL again.

The other arguably more helpful way that IE5 saves text-entry time is with forms. When you start to fill in a

will take you to the site that most closely matches that keyword. It will also open the Search pane and present you with a list of additional choices, saving research time if its guess isn't correct.

It's now easy to use many search engines in IE5 without having to visit each one separately. Simply choose the Next button in the search pane and click through to the next search engine or opt for the drop-down menu to get a choice of eight different search engines.

One of the goals of IE5 is to save you from having to type the same text over and over.

Web form, a drop-down list appears with previous entries. You can choose the entry you want or type in a new one.

FEATURES FACE-LIFT

Internet Explorer's History and Favorites (bookmarks) features have also gotten face-lifts. You can now view your browsing history by date, site, most-visited site, or the order visited today. Sites are also now sorted by domain name, easing the task of finding the appropriate site in your History list. We were also able to search our History file right from the History bar itself.

Favorites has also undergone some useful changes. Web

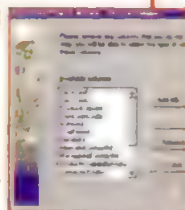


AMD K6-II

This new CPU may help to pull AMD into the high-end PC market. Page 56.

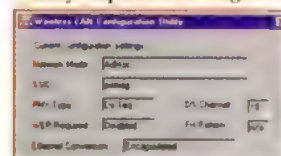
VISUALCAGE 3.0

Symantec Corp.'s new tool brings added ease of use and power to Java development. Page 66.



ZOOMAIR WIRELESS NETWORKING

Want to network your office for less and leave the wires behind? We look at this surprisingly inexpensive family of products. Page 74.



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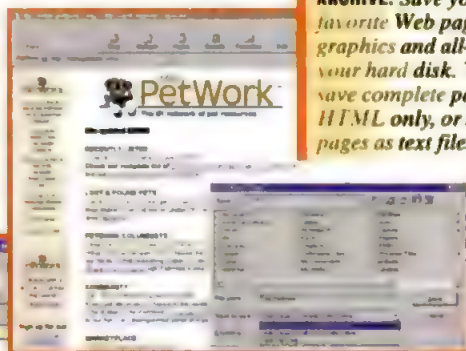
FIRST LOOKS

pages can be added to your Favorites list or organized right from the search pane by clicking on an icon. Book-marked pages can be marked for off-line reading (pages can automatically be downloaded daily, weekly, or on a monthly basis). You can also use the import/export tool to import book-marks from Netscape Communicator.

IE5 now lets you save complete Web pages to a folder on your hard disk. This differs from the

We liked the robust filters for mail and newsgroups, which spare you the burden of reading unnecessary e-mail or flames. And Outlook Express now supports multiple signature files, multiple profiles for different people, and IMAP folder management.

ARCHIVE: Save your favorite Web pages—graphics and all—on your hard disk. You can save complete pages, HTML only, or save pages as text files.



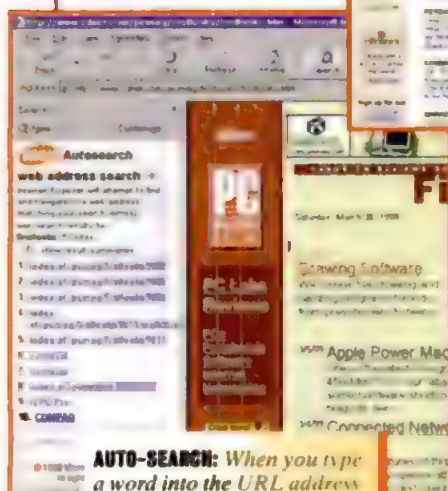
the administrator's distribution area and install the component.

Administrators can also control the amount of involvement that you have with installation by

let you reset your home page as the content provider's page.

Content providers will also be able to add such Web accessories to your browser as customized IE-specific bars, similar to existing bars such as Search and History, but containing custom content. Corporations or hub sites may find this useful in keeping your eyes focused on their content.

Microsoft has also made an effort to increase IE's appeal to developers. IE5 now fully supports the CSS 2.0 standard, as well as XML 1.0. The company has added performance tweaks (see details, below), new



AUTO-SEARCH: When you type a word into the URL address box, IE5 takes you to the key-word that matches most closely and display more results.

built-in off-line-viewing feature: since the files are saved to a folder and not to the browser's cache, they don't expire. The next step should be to add an indexing capability, which will let you build a filing cabinet for saved Web pages, complete with search and sorting capabilities.

You can now choose to use a Web-based e-mail service such as HotMail or Yahoo! Mail as your default e-mail client. When you click an e-mail link or choose to read e-mail or send a Web page, Internet Explorer will automatically connect to your choice of Web e-mail providers.

Outlook Express also now has a new, cleaner interface and enhanced off-line capabilities.

SURF THE RADIO

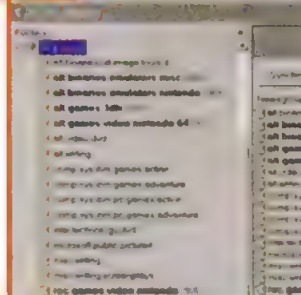
Microsoft has added another unexpected but interesting feature to IE5. If you have Windows Media Player installed, you can use the Radio Bar, a new toolbar that gives you the ability to listen to the radio from within IE5. Once the Radio Bar is turned on, you can select a station from the Radio

Guide and control the volume right from IE's interface.

This feature is turned off by default, so you must go into the Advanced section of Internet Options to turn it on permanently. We felt that a wider selection of stations on the MSN Radio Station guide would give this feature more value.

ADMINISTRATIVE ACTION

The new administration kit for IE5 comes with a number of significant improvements, including an easy-to-use customization wizard. This wizard has been simplified for administrators who want to create their own versions of IE5. You can go through a step-by-step process or use the Feature Selection option to skip ahead to the part that you're interested in altering. Administrators can easily



FACE-LIFT: Outlook Express has a new interface, extensive off-line reading capabilities, and enhanced filtering features to eliminate unwanted e-mail.

designating one of three options: Interactive, Hands-Free, or Completely Silent. The Interactive option lets you customize components during install. Hands-Free will display dialog boxes and error messages during installation, and Completely Silent will keep the installation hidden.

NEWS FOR CONTENT PROVIDERS

IE5 is a boon to content providers as well. One new feature is Home Page Object Model (HPOM), which allows content providers to offer a quick and easy way for you to change your home page using basic scripting. For example, Web sites will now be able to offer a graphical button that will

DHTML technologies, support for enhanced Drag and Drop, and a Developer's Mode to speed debugging.

IE5 supports the W3C's XML document object model, providing developers with control of format, structure, and document content. You can view native XML from within the browser, and developers can apply style sheets to XML documents.

SPEEDING UP PERFORMANCE

Performance issues have been addressed in this release, starting with the addition of a more efficient Dynamic HTML rendering engine. You'll notice this improvement when viewing very large Web pages.

Internet Explorer 5 now supports Fixed Layout Tables, part

of the CSS 2.0 standard. Fixed tables let developers specify exact sizes for columns and rows within a table. When developers use fixed tables, the browser no longer has to examine the entire table before displaying its content. Instead, the browser can draw the rows of a table as it reads them. The end result is a page that loads significantly faster.

HTTP-Expires is another performance enhancement in IE5. Instead of checking the network for object staleness, the browser first checks the user's cache. If the request for that object

Dynamic HTML Behaviors is another new goodie. Instead of having content, style, and script mixed together in a document, developers can use components to separate them. Web pages can now reuse code, so developers can point to scripts, and the pages can then simply reference those scripts.

The separation of content and scripts helps avoid function-

ality meltdown by preventing scripts from being affected when content is changed.

Since the two are separate, script integrity is preserved. Microsoft has submitted this technology to the W3C for review and possible inclusion in future standards.

Microsoft has also included Drag-and-Drop Object Model support in IE5. Developers using the IE5 object model can build Web applications that let you drag and drop content between frames and also to other applications. Additional drag-and-drop functionality includes cursor control, clipboard support, and drag initialization. Another item that developers will like is the Developer Mode, which shows all site and script errors for debugging.

IE5 VS. NETSCAPE 4.51

So how does IE5 stack up against Netscape's Communicator? Although we won't be able to do a true head-to-head comparison until Communicator 5.0

is ready, we can make some comparisons to Version 4.51. IE5's bookmark management features beat Communicator's aging bookmark system. Netscape has an Import feature for bookmarks but lacks IE's Export feature; Netscape's bookmarks are still accessible only via a drop-down menu. IE gives you the option of displaying bookmarks in a separate pane and offers a Cookie Import/Export feature, which Communicator lacks.

Microsoft has taken note of Netscape 4.51's

gator browser. The company has an ActiveX plug-in for IE4 that provides IE users with similar functionality as Communicator users. Once it's installed, IE users have the same Smart Browsing features as Communicator users. The plug-in also provides integrated access to Netcenter by changing the default page in IE to Netcenter. Netscape plans to update the plug-in for use with IE5.

Communicator 4.51 does have one distinct advantage over IE—namely the AOL/Netscape Instant Messenger. Microsoft still does not have a chat pager bundled with its browser. Given the widespread use and popularity of instant messaging, this puts Explorer-only users at a disadvantage if they want to use instant messaging.

Microsoft has done a good job in improving IE's performance while also making it more appealing for developers. IE5 is worth the upgrade if you're using IE already. But for Netscape users who like instant messaging in particular, best wait for Communicator 5.0.

THE VERDICT

Microsoft has done a good job in improving IE's performance while also making it more appealing for developers. IE5 is worth the upgrade if you're using IE already. But for Netscape users who like instant messaging in particular, best wait for Communicator 5.0.

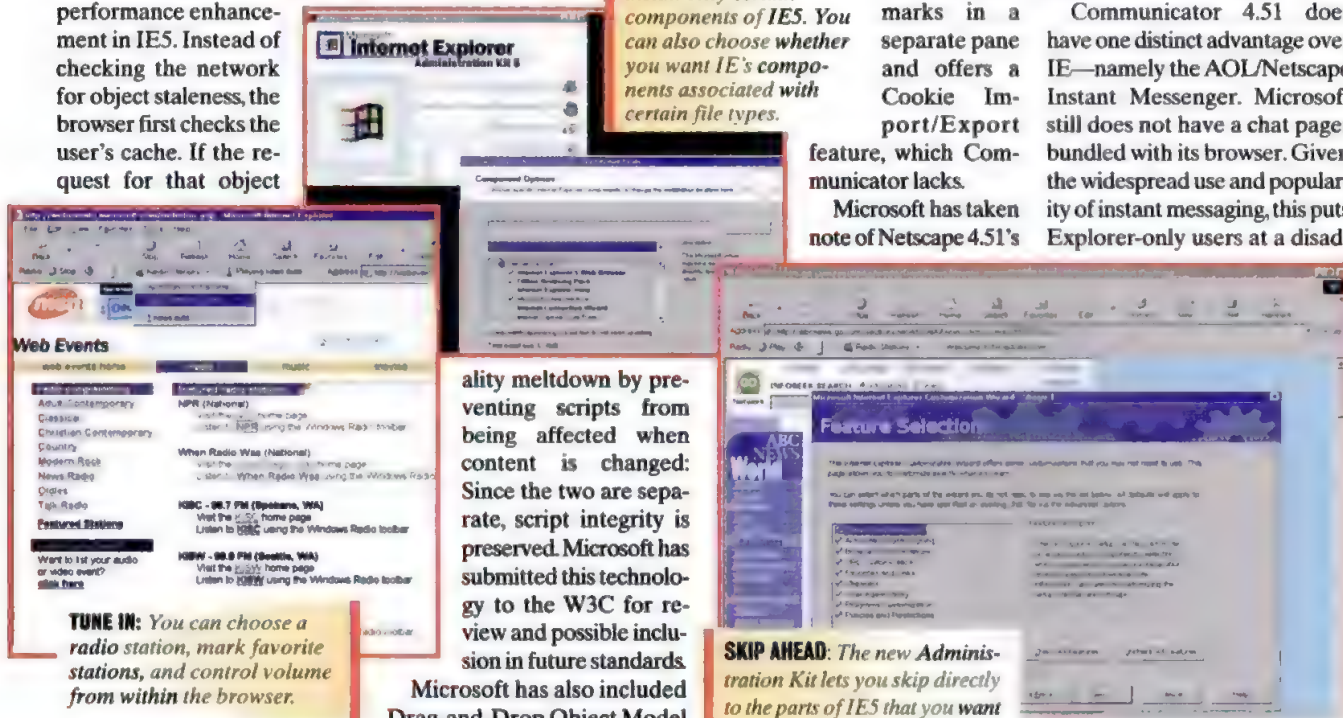
Microsoft Internet Explorer 5. Price: Free download. Requires: 16MB RAM, 7MB to 30MB hard disk space, Microsoft Windows 3.x, 95, 98, or NT 4.0 or better. Microsoft Corp.; 800-426-9400; www.microsoft.com/windows/ie. **PC**

CUSTOM INSTALL: You can now choose to install only certain components of IE5. You can also choose whether you want IE's components associated with certain file types.

SKIP AHEAD: The new Administration Kit lets you skip directly to the parts of IE5 that you want to customize—without having to go through every page.

What's Related feature and added it to IE5. But Netscape's What's Related feature is better integrated with the Netcenter portal. Netscape has also put its What's Related feature in a prominent spot on the browser; Microsoft's is hidden in a drop-down menu (unless you add a button to your interface). In general, Netscape has done a better job of integrating Netcenter into its browser; Microsoft's MSN portal just isn't as prominent in IE5.

Netscape has also taken steps to ensure that its portal and other services are integrated into IE as well as its own Navi-



TUNE IN: You can choose a radio station, mark favorite stations, and control volume from within the browser.

can be satisfied from cache (meaning the object hasn't expired from the cache), IE5 won't bother checking the network for it. In addition to loading content more quickly, this feature also has the potential to cut down on unnecessary network traffic.

Another benefit of the adherence to CSS 2.0 is Dynamic Properties, which lets Web developers perform simple scripting without using scripts. For example, a developer can change the font size of a section of text to fit the size of your browser window just by adding the style information to the text. This way of adding dynamic changes to text is quicker and easier than writing a full script.

Light Up Your Web Site

Macromedia Fireworks 2 raises the Web graphics bar with advanced JavaScript rollover capabilities.

By Luisa Simone

The first release of Macromedia Fireworks established the standard for dedicated Web graphics programs and earned it an Editors' Choice award in our roundup ("Web Graphics," November 3, 1998). Macromedia Fireworks 2 (\$200 street) raises the bar, with more sophisticated HTML output, a streamlined interface, and improved batch processing.

RADICAL ROLLOVERS

The hottest feature in Fireworks 2 is the new Behaviors palette. In addition to simple JavaScript rollovers (that swap one image for another in response to mouse activity), Fireworks 2 can create sophisticated rollovers, where a mouse action on one part of the screen triggers an event in a different area. Behaviors can call external files, reference different frames in a multiframe composition, and display HTML status-line messages. In short, they let designers create an exceptionally interactive interface without writing JavaScript code manually.

To assist professional developers, Macromedia makes it possible to integrate Fireworks 2 more fully into the HTML workflow. Fireworks can export Cascading Style Sheets (CSS) or specific flavors of HTML optimized for Macromedia Dreamweaver or Microsoft FrontPage. For example, a Fireworks composition output as Dreamweaver 2 HTML or a Dreamweaver Library will appear as a native, editable object when opened in Dreamweaver.

BETTER TOOLS AND INTERFACE

You'll see several improvements to Fireworks' image and anima-

tion tools. You can now apply multiple Live Effects to an object or sample colors anywhere on the desktop using the eyedropper found in the Swatches palette. A new onion-skinning feature lets you view multiple frames in an animation simultaneously. You can also play the anima-

tion, in effect functioning as a batch list. We particularly liked the Object Inspector, which now provides an easy mechanism to specify export options or custom names for individual slices of a picture.

Macromedia Fireworks 2 still doesn't offer the advanced automation features found in other

competing products such as Adobe Image Ready or Equilibrium Debabelizer. The new Find and Replace command, for example,

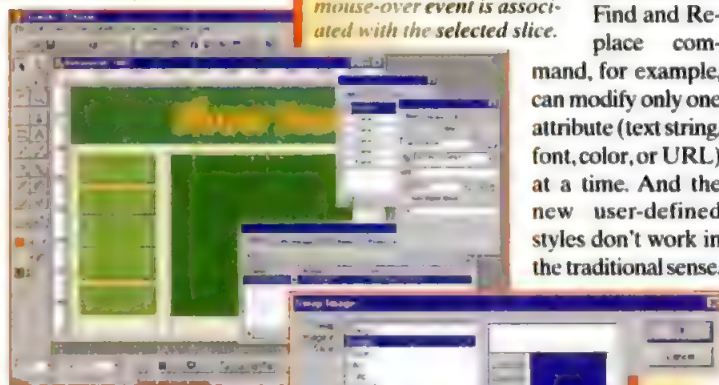
can modify only one attribute (text string, font, color, or URL) at a time. And the new user-defined styles don't work in the traditional sense. Our testing suggests that this feature should be used with caution, however, as it increases file size.

ENHANCING EXPORT

Fireworks 2 offers improved export options for both GIF and JPEG output. A new sharpening filter can clean up JPEG artifacts that typically appear along hard color boundaries. We found the ability to manipulate GIF palettes directly to be much more useful. We especially liked the ability to lock a color or snap a selected color to a Web-safe hue. Designers will appreciate the new wizard

create an entirely new style. The new batch functions do make Fireworks more suitable for a production environment, however. Batch operations can now run across multiple folders, include both search-and-replace and export operations, and generate automatic backups. You can also save batch operations as reusable Scriptlets.

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ROLL IT OVER A JavaScript rollover is easy to create. Here, a multiframe composition contains named slices (shown as transparent green overlays). The Behaviors palette shows that a mouse-over event is associated with the selected slice.

tion in the workspace (instead of in the Export dialog box).

You'll also enjoy productivity boosts delivered by the revamped interface. The Hotspot and Slice functions are now integral parts of the program, with the tools conveniently located on the main toolbar and the objects stored on a standard layer. Tabbed palettes, which can be rearranged, provide access to a host of new management functions.

The URL Manager, for example, keeps track of the URLs in the current document and can even import URLs from an external HTML file—no

typing necessary. The new Project Log will record the names of files affected in a batch oper-

ation, in effect functioning as a batch list. We particularly liked the Object Inspector, which now provides an easy mechanism to specify export options or custom names for individual slices of a picture.

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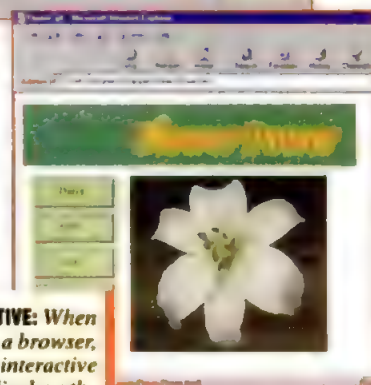
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TAKE AIM: The Swap Image behavior lets you choose a target area for the rollover that is different from the event area; you can also specify whether the new image should come from an external file (as shown here) or from another frame in the Fireworks file.



INTERACTIVE: When viewed in a browser, this interactive graphic displays the image of the lily when the mouse is held over the button of the same name. The image changes as the mouse moves.

Once applied, the relationship between a style and the object is no longer live, so you can't edit a style

to update existing objects within a document. In fact, to change a style's attributes, you must

that compresses a file or GIF animation to a specified size.

Fireworks 2 distinguishes itself from the competition with exceptional HTML output—in the form of sophisticated JavaScript effects and integration with HTML editors. These same features also make Fireworks irresistible to professional Web designers.

Macromedia Fireworks 2. Street price: \$200; upgrade, \$130; bundled with Dreamweaver 2, \$400. Requires: 32MB RAM (40MB for NT); 60MB hard disk space; Microsoft Windows 95, 98, or NT 4 or later. Macromedia, San Francisco; 415-252-2000; www.macromedia.com.



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Rapid-Fire Capture

The Kodak DC265 camera features faster image processing and increased standard storage.

By Bruce Brown

An improvement on the Kodak DC260, a top seller from last year, Eastman Kodak Co.'s new Kodak DC265 digital camera (\$1,000 street) boosts both value and features for those who want great images. Now standard with a 16MB CompactFlash (CF) card (increased from the DC260's 8MB card) and nickel hydride batteries with charger, the DC265 also adds a lower compression-ratio setting, which produces top-quality images, faster image processing, and the ability to capture six full-resolution images in burst mode.



Many features of the 1.6-megapixel, 1,536-by-1,024-resolution DC265 match those of the DC260, which is still on the market at \$800 (street). For details

on the cameras' aperture range, lens type, zoom capability, and output methods, see the First Looks review in our issue of October 6, 1998.

In addition to an optical viewfinder, the DC265 has a 2-inch-diagonal color LCD for composing images, playback

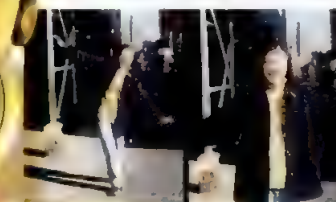


PHOTO FINISH: The Kodak DC260 can capture and process six images in less than half a minute.

and review, and a display for navigating menus. The camera uses Flashpoint Technology's Digita operating system for managing and viewing images

and for running custom scripts.

The time saved when using the DC265 compared with the DC260 is impressive. In testing both cameras with freshly charged batteries, the DC265 took just 7 seconds to power up to take a first shot; a DC260 upgraded with the latest version of



Digita (1.0.6) took 11.6 seconds. We noted even more substantial improvement in the time the cameras

required to process images. The DC260, which captures two images before processing, took 119 seconds to capture and process six 1.6-megapixel images. The DC265 captured and processed six similar images in just 27 seconds.

Image quality of the DC265, as with the DC260, remains the standard for other sub-2-megapixel cameras to match. Details and colors are right on, and the camera's four flash options, four white-balance modes, exposure timing, and external flash synchronizing all add to the package.

In addition to bundled Adobe PhotoDeluxe and Page-Mill software, the DC265 also will initially ship with an accessory kit containing a parallel-port CF card reader, an 8MB CF memory card, four extra double-A nickel hydride batteries, and a CF card PC Card adapter.

Although you now can find plenty of low-cost megapixel cameras, the Kodak DC265 is a winner. It has a proven design that's now faster, comes with a complement of rechargeable batteries, and includes more storage and a variety of image-file-transfer methods and accessories.

Kodak DC265. Street price: \$1,000. Requires: 16MB RAM for Windows 95 and 98, 32MB RAM for Windows NT 4.0; 70MB hard disk space. Eastman Kodak Co., Rochester, NY; 800-235-6325; www.kodak.com.

In-Camera Image Editing

Traditionally, to edit or add special effects to digital-camera images, you had to upload the images to a PC and run photo-editing software. Digita Technology's Digita FX (\$19.95 direct, via download) lets you manage several key image settings and apply special effects directly to images while they're stored in a camera.

Digita FX works only with cameras that use the Digita operating system—currently the Kodak DC220, the DC260, and the DC265, as well as the Minolta Dimage EX Zoom 1500.

To use the program with images stored on a camera's removable memory card (the Kodak and Minolta cameras use CompactFlash cards), you must have Digita FX installed on the same card. After you download the program, an installer program walks you through the process of putting the application on the media.

To use Digita FX, you start the camera, go to the Applications menu, select Digita FX, and then tap the camera's Start button, which shuts the camera down. When you restart the camera, Digita FX opens automatically and loads all of the images on the same piece of storage media, ready for selection.

Digital FX's editing features let you make adjustments to contrast, brightness, sharpness, Gaussian blur, RGB color balance, and color saturation. You can convert color shots to gray-scale, colorized, or posterized images. Special-effects filters let you emboss or pixelate images or apply mosaic, stucco, underwater, and watercolor or surface effects. You can make only one adjustment at a time. You then have to save the image before making another change. During testing, we



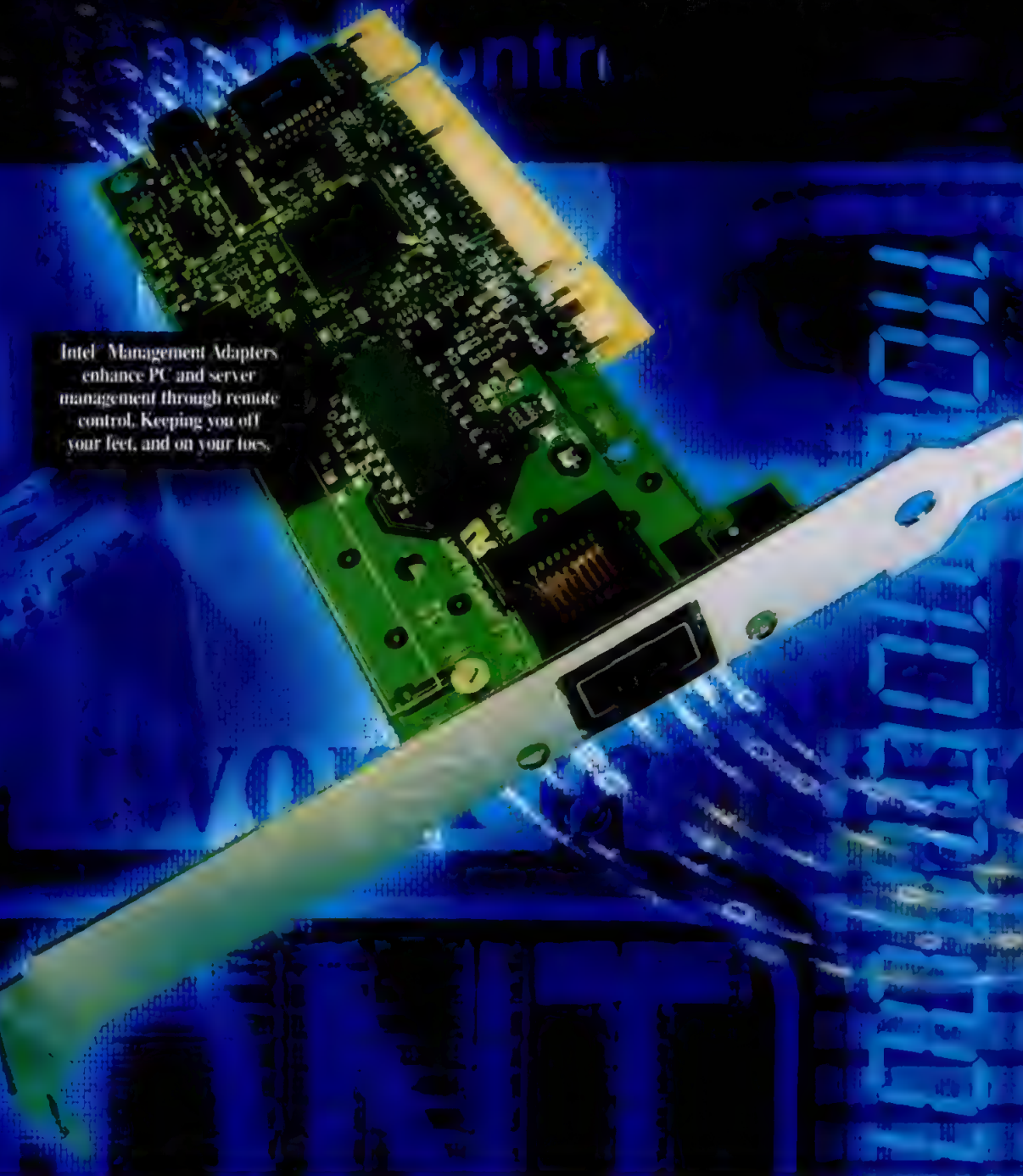
SALTY DOG: This photo shows Digita FX's underwater effect.

often had difficulty seeing the effects of changes on the Kodak DC260's 2-inch diagonal LCD panel.

Digita FX is no substitute for even average photo-editing software, but people who don't want to bother with transferring images to a PC before printing or sharing them will find this new program's features convenient—if sometimes awkward to use.—BB

Digita FX. Direct price: \$19.95. Requires: The Kodak DC220, DC260, or DC265 with Digita OS 1.0.8, or the Minolta Dimage EX Zoom 1500 with Digita OS 1.0. FlashPoint Technology Inc., San Jose, CA; 888-820-3644; www.flashpoint.com.

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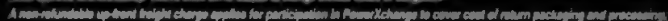
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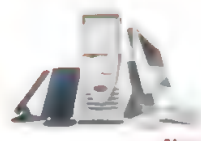
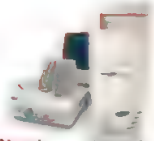
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RAM	64MB SDRAM	64MB 100MHz SDRAM	64MB 100MHz SDRAM	128MB PC100 SDRAM	128MB 100MHz SDRAM
Hard Drive	8.4GB Ultra ATA hard drive*	13GB Ultra ATA hard drive*	13GB Ultra ATA hard drive*	20GB Ultra ATA hard drive*	20GB Ultra ATA hard drive*
Monitor	17" Micron 700Hz monitor (15.5" display)	17" Micron 700Hz monitor (15.5" display)	17" Micron 700Hz (15.5" display) monitor	17" Micron 700Hz (15.5" display) monitor	15" Micron LCD flat panel display
DVD/CD-ROM	48X CD-ROM drive*	48X CD-ROM drive*	48X CD-ROM drive*	48X max speed DVD-ROM drive	48X max speed DVD-ROM drive
Modem	3Com USRobotics V.90 WinModem**	3Com USRobotics V.90 WinModem**	3Com USRobotics V.90 WinModem**	3Com USRobotics V.90 WinModem**	3Com USRobotics V.90 WinModem**
Graphics	3Dfx Voodoo 3D graphics with 2MB VRAM	3Dfx Voodoo 3D graphics with 2MB VRAM	3Dfx Voodoo 3D graphics with 2MB VRAM	3Dfx Voodoo 3D graphics with 2MB VRAM	3Dfx Voodoo 3D graphics with 2MB VRAM
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Training	1-year free training @ Micron U online	1-year free training @ Micron U online	1-year free training @ Micron U online	1-year free training @ Micron U online	1-year free training @ Micron U online
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Note: additional configurations may offer more speed-saving configurations. *24-hour direct access consultant with 1000 equal to 1 billion bytes. ¹The TransPort TREK² Windows system was ranked #1 by PC World. ²At the time of writing, the winner was the "Micron TransPort TREK² System (Pentium II Processor 366MHz, 32MB SDRAM, 14.1" XGA TFT Display, 24X CD-ROM Drive, 3.5" Floppy Drive, 10GB Hard Drive, 4MB AGP Graphics, 320MB SDRAM, 366MHz Pentium II Processor, 1 Year Free Training at Micron U). ³For all Micron PCs equipped with Windows 98. ⁴For all Micron PCs equipped with Windows 98. ⁵For all Micron PCs equipped with Windows 98. ⁶For all Micron PCs equipped with Windows 98. ⁷For all Micron PCs equipped with Windows 98. ⁸For all Micron PCs equipped with Windows 98. ⁹For all Micron PCs equipped with Windows 98. ¹⁰For all Micron PCs equipped with Windows 98. ¹¹For all Micron PCs equipped with Windows 98. ¹²For all Micron PCs equipped with Windows 98. ¹³For all Micron PCs equipped with 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4

VOL. 15/NO. 10
1994

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travel, read only a page.
—William Goins, III

"First things first: we've got to acknowledge the fastest Pentium-class notebook that we have ever tested - TransPort TREK²."

—CNET, January '99



TREK² 300



TREK² 300



New!
TREK² 333



New!
TREK² 366

366MHz
Power Special

Model Name	TREK ² 300	TREK ² 300	TREK ² 333	TREK ² 366
Processor	Intel® Celeron® processor 300MHz	Intel Pentium II processor 300MHz	Intel Pentium II processor 333MHz	Intel Pentium II processor 366MHz
Cache	128KB L2 pipeline burst cache	256KB L2 pipeline burst cache	256KB L2 pipeline burst cache	256KB L2 pipeline burst cache
RAM	32MB EDO DRAM	64MB SDRAM	64MB SDRAM	128MB SDRAM
Hard Drive	4.3GB hard drive (removable)*	6GB hard drive (removable)*	6GB hard drive (removable)*	10GB hard drive (removable)*
Monitor	12.1" SVGA TFT display	13.3" XGA TFT display	14.1" XGA TFT display	14.1" XGA TFT display
Extra Storage	3.5" floppy disk drive (dedicated bay)	3.5" floppy disk drive (dedicated bay)	3.5" floppy disk drive (dedicated bay)	3.5" floppy disk drive (dedicated bay)
CD-ROM	24X CD-ROM drive* (dedicated bay)	24X CD-ROM drive* (dedicated bay)	24X CD-ROM drive* (dedicated bay)	24X CD-ROM drive* (dedicated bay)
Graphics	4MB AGP graphics accelerator	4MB AGP graphics accelerator	4MB AGP graphics accelerator	4MB AGP graphics accelerator
Sound System	Built-in stereo speakers & microphone	Built-in stereo speakers & microphone	Built-in stereo speakers & microphone	Built-in stereo speakers & microphone
Warranty	3-year/3-year Micron limited warranty	3-year/3-year Micron limited warranty	3-year/3-year Micron limited warranty	3-year/3-year Micron limited warranty
Software Included	Microsoft® Windows® 98 System Wizard Mobile Client™ Norton AntiVirus	Microsoft Windows 98 Microsoft Office Small Business Edition Free* Upgrade to Microsoft Office 2000 System Wizard Mobile Client™ Norton AntiVirus	Microsoft Windows 98 Microsoft Office Small Business Edition Free* Upgrade to Microsoft Office 2000 System Wizard Mobile Client™ Norton AntiVirus	Microsoft Windows 98 System Wizard Mobile Client™ Norton AntiVirus
Training:	1-year free* training at Micron U online	1-year free* training at Micron U online	1-year free* training at Micron U online	1-year free* training at Micron U online
Also Includes:	Zoomed Video capable Li-Ion battery (dedicated bay) Microphone, stereo line-in/out jacks Touchpad pointing device CardBus ready S-Video & NTSC out; MPEG compatible WaveTable/3D Positional Sound 2-way fast infrared port 2 Type II/1 Type III PCMCIA slots 2-USB, parallel, serial, VGA, PS/2 ports Add Port Replicator \$199	Zoomed Video capable Li-Ion battery (dedicated bay) Microphone, stereo line-in/out jacks Touchpad pointing device CardBus ready S-Video & NTSC out; MPEG compatible WaveTable/3D Positional Sound 2-way fast infrared port 2 Type II/1 Type III PCMCIA slots 2-USB, parallel, serial, VGA, PS/2 ports Add Port Replicator \$199	Zoomed Video capable Li-Ion battery (dedicated bay) Microphone, stereo line-in/out jacks Touchpad pointing device CardBus ready S-Video & NTSC out; MPEG compatible WaveTable/3D Positional Sound 2-way fast infrared port 2 Type II/1 Type III PCMCIA slots 2-USB, parallel, serial, VGA, PS/2 ports Add Port Replicator \$199	Zoomed Video capable Li-Ion battery (dedicated bay) Microphone, stereo line-in/out jacks Touchpad pointing device CardBus ready S-Video & NTSC out; MPEG compatible WaveTable/3D Positional Sound 2-way fast infrared port 2 Type II/1 Type III PCMCIA slots 2-USB, parallel, serial, VGA, PS/2 ports Add Port Replicator \$199
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8MB nVidia Riva128X AGP graphics
66-value PCI Modem/sound
3Com 3C905 WOL 10/100 network card
5-year/3-year Micron Power® limited warranty
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Intel LANDesk® Client Manager
Microsoft Windows NT Workstation 4.0
Bertram AntiVirus

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Chassis intrusion detection
Fan, temperature, and voltage problem reporting
Virus detection reporting
Remote Wake Up capability
Microtower case
3.5" floppy drive
104-key enhanced keyboard
Microsoft IntelliMouse®

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17" Micron 700Hz (15.9" display)
4GB max speed CD-ROM drive*
8MB Real 3D Starfighter AGP graphics
66-value PCI Modem/sound
3Com 3C905 WOL 10/100 network card
5-year/3-year Micron Power® limited warranty
1-year free* training @ Micron U online

Intel LANDesk® Client Manager
Microsoft Windows NT Workstation 4.0
Bertram AntiVirus

SMART II hard drive monitoring
Chassis intrusion detection
Fan, temperature, and voltage problem reporting
Virus detection reporting
Remote Wake Up capability
Microtower case
3.5" floppy drive
104-key enhanced keyboard
Microsoft IntelliMouse®

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NEW! NetFRAME 3101

The Top-Rated Web Server* PC Computing News '99

Intel Pentium III processor 500MHz
32KB Internal L2 ECC cache
128MB ECC 100MHz SDRAM
6GB UFW LPM5 SCSI 3" hard drive*
32X max speed CD-ROM drive*

5-year/3-year Micron Power limited warranty
Dedicated server technical support, 7x24
1-year next-business-day on-site service***

Intel LANDesk Server Manager
Emergency Management Port Console

Supports up to four Intel Pentium III processors
500MHz frontside bus and up to 1GB memory support
Integrated Ultra Wide SCSI-3 dual channel controller
Intel P80/100+ Server Adapter
Integrated RAID upgrade support
5 expansion slots: 3 PCI, 1 ISA, 1 shared PCI/ISA
8 drive bays: 1 external 3.5", 2 external 5.25"
5 hot-swap redundant 1.5" hard drive bays

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NEW! NetFRAME 6200

High-Powered Server For Fast-Growing Businesses

Intel Pentium III Xeon processor 500MHz
64MB Integrated L2 ECC cache
128MB ECC 100 SDRAM
6GB UFW LPM5 SCSI 3" hard drive*
32X SCSI CD-ROM drive*

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Dedicated server technical support, 7x24
1-year next-business-day on-site service***
NDS support (3 first-year incident resolutions)

Intel LANDesk Server Manager 6.0
Emergency Management Port Console
Microsoft Windows NT Server 4.0 (10-user license)

Supports up to four Intel Pentium III Xeon processors
Options for 512KB, 1MB or 2MB L2 cache
4GB ECC EDD support (16 SDRAM sockets)
Integrated Ultra-2 Wide SCSI dual channel 6
cutter SCSI controller
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The Mission-Critical Enterprise Server

Intel Pentium III Xeon processor 500MHz
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32X max speed CD-ROM drive*

5-year/3-year Micron Power limited warranty
Dedicated server technical support, 7x24
1-year next-business-day on-site service***
NDS support (3 first-year incident resolutions)

Intel LANDesk Server Manager 6.0
Emergency Management Port Console
Microsoft Windows NT Server 4.0 (10-user license)

Supports up to four Intel Pentium III Xeon processors
Options for 512KB, 1MB or 2MB L2 cache
4GB ECC EDD support (32 SDRAM sockets)
Intel P80/100+ Server Adapter w/Adaptive Load
Balancing and Adapter Fault Tolerance software
Integrated Ultra-2 Wide LPM5 dual channel controller
10 expansion slots: 4 hot-plug ready 64-bit PCI slots,
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Amazing Artistic Effects

Adobe After Effects 4.0 gives professional artists the tools to be more creative and productive.

By Luisa Simone

Professional video artists rely on Adobe After Effects to generate complex overlays, 2-D keyframed animations, and special effects that combine live footage with computer-generated imagery. The enhancements in Version 4.0 (\$2,200 street, Production Bundle) make the program exponentially more powerful.

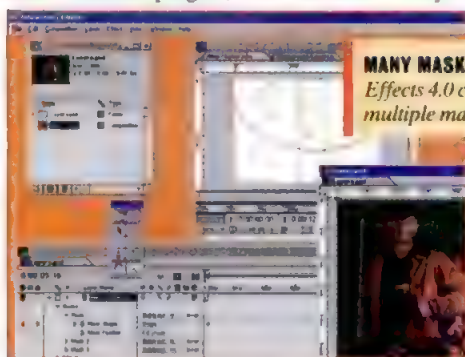
Integration with other Adobe products is a prime objective for After Effects 4.0. Users of Illustrator or Photoshop will find the new tabbed palettes familiar. And After Effects has a better understanding of its siblings' file formats, allowing you to import multilayer compositions from Illustrator, Photoshop, or Premiere.

After Effects will even maintain adjustment and effects layers in a Photoshop file. A Hue/Saturation adjustment layer, for example, can be modified and animated by changing the associated values or adding masks. We were very impressed with the new adjustment layers that can be created internally, because they aren't limited to image-enhancement functions.

As a high-end compositing program, After Effects has always offered masking. But in Version 4.0, each layer in a composition can contain up to 128 vector-based masks. Paths can be imported from either Illustrator or Photoshop or can be created using the enhanced Bezier tool (which functions identically to the one in Photoshop). You can achieve some spectacular effects with masks, thanks to the abilities to animate their shapes and to determine how multiple masks interact.

Like earlier versions of After Effects, Version 4.0 clearly dis-

tinguishes between two target markets: motion graphics designers and special effects artists. With the addition of guides, grids, and an align/distribute plug-in, the Standard



MANY MASKS: Layers in an After Effects 4.0 composition can contain multiple masks (shown as vector paths).

where parameters such as frequency, velocity, and gravity let designers generate complex natural phenomenon like rain or explosions.

After Effects puts a unique spin on particle generation by allowing

you to substitute type or source footage for a computer-generated particle. For example, instead of a series of dots traveling across the screen, you can quickly animate a herd of elephants, where the placement and foot position of each animal appears to be random.

After Effects 4.0 delivers what professional artists want—tools that make them more productive, leaving them free to be more creative.

Adobe After Effects 4.0, Production Bundle. Street price: \$2,200; upgrade, \$300 (standard version, \$1,000; upgrade, \$200). Requires: 32MB RAM for Windows 98, 64MB RAM for NT; 80MB hard disk space, Windows 98 or NT 4.0 or later. Adobe Systems Inc., San Jose, CA; 408-536-6000; www.adobe.com.

The Small Picture

Literally book-size, the Sony VAIO C1 PictureBook Computer packs big multimedia extras.

By Cade Metz

Following a successful debut in Japan, the Sony VAIO C1 PictureBook Computer—a 2.4-pound Windows 98 portable with an integrated video camera—recently arrived stateside with new hardware, including a 266-MHz Pentium MMX processor and a 4.3GB hard disk. Though this machine (\$2,299 direct) has a limited battery life and lacks several common I/O devices, its camera and chassis make for a uniquely attractive PC.

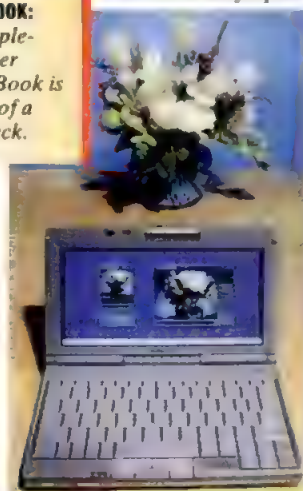
Resembling a slightly elongated paperback novel, the PictureBook's small chassis measures only 1.5 by 9.5 by 5.5 inches (HWD). It offers a touch-typable 17mm keyboard and an 8.9-inch TFT display that affords surprisingly crisp graphics.

Because the wide display runs at a 1,024-by-480 resolution rather than the standard 1,024-by-768, we aren't able to provide

relevant Winstone test scores for the PictureBook. But its core hardware—including 512K of L2 cache and 64MB of SDRAM, as well as a 266-MHz CPU—is likely half as fast as that of a 366-MHz Pentium II portable.

On our BatteryMark measure, the machine lasted just 1 hour and 40 minutes. Battery life can be extended with a replacement battery pack

LIKE A BOOK: The purple-and-silver PictureBook is the size of a paperback.



(\$299.99 direct), but this also extends the depth of the system by about an inch.

This machine's strengths lie in its multimedia offerings: In addition to the standard suite audio applications and VAIO image editing, the PictureBook includes an integrated Motion Eye video camera and software for capturing both still and moving images. The camera sits on a swiveling hinge just above the display.

Though the main system includes a PC Card bay, an integrated V.90 modem, and USB, FireWire, and IrDA ports, it lacks a floppy disk drive and a CD-ROM drive as well as serial, parallel, and VGA ports. Sony ships the system with an external VGA adapter and floppy disk drive, but you'll have to pay extra for a serial/parallel adapter (\$89.99) or a CD-ROM drive (\$299.99).

Scoring a B on our Service and Reliability Survey, Sony offers modest technical support, but the company knows how to build a PC. The PictureBook is only the latest example.

Sony VAIO C1 PictureBook Computer. Direct price: \$2,299. Sony Electronics, San Jose, CA; 888-315-7669; www.sony.com/pc.

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Reinventing the Power Mac

Apple's affordable new Power Macintosh G3 machines pack a punch, but they lack a few essentials.

By Troy Dreier

Mac fans can rejoice: The new line of professional Apple Macintosh G3s is enticing both to the eye and to the pocketbook. They'll also be glad to read that the 400-MHz G3 (\$2,999 list) we tested outperformed a 450-MHz Pentium II PC on a few of our tests and ably held its own on others. A few things are missing, however, including removable storage.

POWER PERFORMER

The G3 did quite well on tests we developed for both platforms. On our Adobe Photoshop tests, the G3 showed impressive results, besting a 450-MHz Pentium II-based Dell Dimension XPS by an average of 35 percent on all but one of 13 specific tests. For complete test results and information on how we tested, join us online at www.firstlooks.com. This line of G3s is the first to ship with the new ATI RAGE 128 graphics accelerator card with 16MB of SDRAM.

EASY SETUP, FAST CONNECTIONS

Basic setup was a breeze, taking about 3 minutes to connect the tower, monitor, keyboard, and mouse. The most striking feature of the G3 is the easy access

to internal components. On the right side of the tower is a hinged door. Pull on the handle and the door opens, so there's no need to go searching for that special screwdriver.

Our 400-MHz test system utilized 1MB of L2 cache running at 200 MHz and 128MB of SDRAM, running on a 100-MHz bus. There are three 64-bit PCI slots, plus a fourth 66-MHz PCI slot dedicated to the ATI RAGE card. One of the 64-bit slots was used by a SCSI card for the system's 9GB Ultra2 LVD SCSI hard disk. You can save a PCI slot should you opt for either a 6GB or 12GB Ultra ATA hard disk. This G3 also came equipped with a 24X CD-ROM drive.

We found the lack of a removable storage device frustrating. External storage is a must, and buyers who don't already have a device should factor one into the purchase price. A Zip Drive is available as a built-in extra for \$100.

Around back, the G3 has two FireWire ports, two USB ports, and an Apple Desktop Bus (ADB) port. Though the G3's USB and FireWire ports are great improvements over SCSI

and ADB in terms of speed and connectivity, you'll need to spend extra money on adapters for your old SCSI devices, modems, and printers. And you'll definitely want to hang onto your old Apple keyboard. The G3 400 ships with the same flimsy, cramped keyboard and round mouse designed for the iMac.

The only applications included are Internet essentials, such as Netscape 4.05, Internet Explorer 4.01, Outlook Express 4.0, and America Online 4.0. Connecting

mondron CRT (\$499 list) has a 16-inch viewable area and a 0.25mm aperture grille pitch. The display produced a clear, sharp picture, but we found two very faint blue lines across the screen slightly distracting.

We also took a look at Apple's 15.1-inch Flat Panel Apple Studio Display (\$1,099 list). It has a 120-degree horizontal viewing angle and produces sharp, vivid colors. Its stand can swivel 45 degrees upward, 10 degrees downward,

GEE WHIZ: The Power Macintosh G3s deliver great performance; shown are Apple's flat-panel and CRT displays.



to the Internet, however, was easy. A step-by-step guide helps users find an ISP in their area. Net surfers will need to provide their own modems, but corporate users can use the machine's Fast Ethernet port to access the company Internet connection.

DISPLAY OPTIONS

Apple provided its 17-inch Studio Display monitor for review. The 17-inch Mitsubishi Dia-

and 45 degrees from side to side.

The new G3s are impressive machines, with great styling, hardware innovations, and performance. A wish list of improvements would start with removable storage and a better mouse and keyboard.

Apple Power Macintosh G3. List price: \$2,999. Apple Computer Inc., Cupertino, CA; 800-538-9696, 408-996-1010; www.apple.com.

PERFORMANCE TESTS

Apple Power Macintosh G3 vs. Pentium II



The 400-MHz G3-based Power Macintosh performed extremely well on cross-platform tests developed by our Labs. On 12 out of 13 Adobe Photoshop tests (not all shown here), the Power Mac outgunned a 450-MHz Pentium II-based comparison system by an average of 35 percent.

Our Quake results show the PC outperforming the G3 by a

small margin, contrary to information on Apple's Web site. Apple compared the 3D Rave version of Quake for the Mac (which is hardware accelerated) against the software-accelerated version of Quake on the PC. We ran our tests using the hardware-accelerated versions for both platforms.

For more test results visit us online at www.firstlooks.com.

▲ High scores are best.

▼ Low scores are best.

Bold type denotes first place.

Apple Power Macintosh G3 (G3/400)
Dell Dimension XPS (Pentium II/450)

FILEMAKER PRO 4.0

Import (seconds) ▼	Sort (seconds) ▼	Export (seconds) ▼
23.7	41.4	16.3
29.3	58.4	20.8

ADOBE PHOTOSHOP 5.02

Gaussian Blur—MMX

30MB file (seconds) ▼	100MB file (min. sec) ▼
9.3	1:34
11.6	2:36

Lighting Effects— Floating Point

30MB file (min. sec) ▼	100MB file (min. sec) ▼
1:17	4:31
1:04	4:41

QUAKE

TimeDemo1 (frames per second) ▲
92.3
112.7



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K6-III: AMD Aims High

With TriLevel cache and 3DNow!, AMD's new CPU makes possible a powerful PC at a lower price.

By Cade Metz

Right in line with early media speculation, the new K6-III processor, from AMD, is arguably the company's first CPU capable of competing at the high end of the PC market. Augmenting its K6-2 design with a larger and partially faster cache, AMD has fashioned a CPU that performs nearly as well on common business applications as Intel's leading chip, the 500-MHz Pentium III.

Such performance is particularly impressive, considering that the K6-III runs at lower clock speeds (400 or 450 MHz) than the Pentium III and sells to PC manufacturers for much lower prices. Backed by the Super7 motherboard platform, the chip poses a significant threat to Intel in the world of basic 2-D computing.

Yet the K6-III is not as proficient as the Pentium III when handling raw floating-point calculations. This problem is mitigated when the chip's 3DNow! instruction set is used—as it is under our 3D WinMark test and other applications—but the chip's 3-D performance is still a step behind that of Intel's CPUs.

With this, our first K6-III roundup, we examine the chip's basic architecture and its relative abilities, then review two inaugural 450-MHz K6-III systems: the Compaq Presario 5600s (\$2,549 direct) the CyberMax Enthusiast 3 Daredevil (\$1,899 direct). Similar machines will soon be available from Polywell Computers and TigerDirect, two longtime AMD partners.

K6-III ARCHITECTURE

At its core, the K6-III is essentially identical to its predecessor, the AMD K6-2. It uses the same six-issue RISC86 superscaler microarchitecture and benefits from both the MMX instruction

set introduced by Intel in early 1997 and the 3DNow! instruction set pioneered by AMD just last year. Housed in a ceramic pin-grid array package, it also plugs into the same Super7 motherboard platform as the latest K6-2, a platform that affords AGP graphics as well as a 100-MHz front-side bus.

Still, the K6-III is a significant improvement over existing AMD chips, thanks to a new TriLevel cache design that backs the core CPU with two on-chip caches and a third cache that sits on the motherboard. Current 400-MHz K6-2 systems use two levels of cache: an on-chip 64K L1 cache that runs at full processor speed and a 512K-to-1MB external L2 cache that runs at the speed of the front-side bus. By contrast, the K6-III has two on-chip caches (64K of L1 and 256K of L2 cache). And current Super7 motherboards support up to 2MB of external L3 cache.

With the Enthusiast, for example, CyberMax complements the 450-MHz K6-III with 512K of L3 cache running on a 100-MHz bus. Thus the system benefits from 64K of 450-MHz L1, 256K of 450-MHz L2, and 512K of 100-MHz L3 cache.

AS FAST AS PENTIUM III

By advocating three levels of caches, AMD intends the K6-III to be a processor for the high end of the PC market, rather than the low end where the K6-2 was so successful. The performance of both the Enthusiast and the Presario units during our testing certainly supports such positioning.

Due to its enlarged cache, the 450-MHz K6-III typically scores

roughly 20 percent higher on our CPUmark 99 test than the average Pentium III. This advantage does not translate to its score on the Winstone test, our measure of 2-D computing performance.

Equipped with 128MB of memory, a 7,200-rpm IBM hard disk, an STB Velocity graphics card (based on nVidia's RIVA TNT accelerator), and the ALi Aladdin 5 Super7 core-logic chip set, the 450-MHz Enthusiast scored less than 1 percent lower on Winstone than the average machine in our first Pen-

ciencies in the MVP3 chip set.

Still, accounting for performance variations due to motherboard implementations, chip sets, and peripherals, the K6-III allows system vendors to provide virtually equivalent performance to Intel's 500-MHz Pentium III processor on mainstream applications for far fewer bucks.

FLOATING POINT LAGS

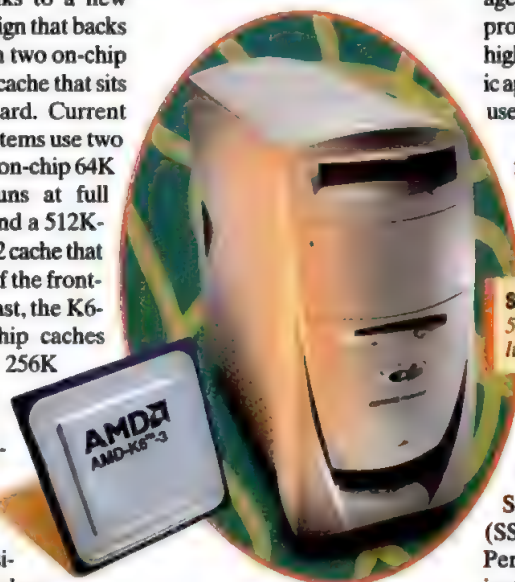
On our FPU WinMark test (a measure of floating-point performance), the systems did not perform nearly as well, scoring about 40 percent lower than the average Pentium III. This isn't a major problem unless you're running high-end engineering or scientific applications, which mainstream users aren't apt to do.

A much larger bottleneck for Direct3D games would exist during 3-D geometry processing if not for 3DNow!, a technology

SLEEK: The Compaq Presario 5600s looks great but has little expansion room.

that improves multimedia and floating-point performance under certain conditions, much like Intel's Streaming SIMD Extensions (SSE), which debuted with the Pentium III. Because 3DNow! instructions are used by Microsoft's DirectX 6.1 transform and lighting engines, the two K6-III systems exhibited fair 3-D performance, scoring roughly 15 percent lower on our 3D WinMark test than the typical PIII system. 3D WinBench also uses DirectX 6.1 during testing to enable support for the Pentium III's Streaming SIMD Extensions as well.

3DNow! provides additional performance improvements under applications specifically coded to use the instructions, including IBM's ViaVoice and many popular 3-D games. We have yet to compare 3DNow! with SSE, but we'll do so as



more applications are coded for both technologies.

IT'S A BARGAIN

Regardless of its lack of strong floating-point performance, the K6-III is a tremendous bargain. At 450 MHz, it sells for \$220 less than the 500-MHz Pentium III and \$20 less than the 450-MHz Pentium II. Consequently, CyberMax and Compaq are able to offer high-end PCs at midrange prices. A Pentium III equipped like the CyberMax Enthusiast 3 Daredevil or the Compaq Presario 5600s sells for upwards of \$2,700.

AMD hopes to gain even more leverage by midyear, when it plans to replace the K6-III at the high end of the market with the AMD-K7—a chip with a new nine-issue superscalar microarchitecture, a pipelined superscalar floating-point unit, and a package that resembles that of the Pentium II or III. Likely to debut at 500 MHz, the chip will sit on a circuit board with half-speed L2 cache and plug into the so-called Slot A interface, which is physically similar to Intel's Slot 1 but uses a 200-MHz bus.

Like the K6-III, the K7 will be manufactured on a 0.25μ process to begin with, but should graduate to a new 0.18μ process by the end of the year and shrink from 184 mm² to a scant 100 mm². But for the moment, the 118 mm² K6-

PACKED: *The Enthusiast 3 Daredevil has brilliant sound and strong performance.*

III is the chip to drive AMD's market share to even greater heights.

COMPAQ PRESARIO 5600S

Part of the new Compaq Internet PC Series, the Compaq Presario 5600s (\$2,549 direct) boasts several new and intriguing technologies, but the machine tested at PC Labs was without DVD player software, speakers, and printed documentation. Though Compaq says these items will accompany the shipping system, the jury is still out on this particular machine's DVD playback and audio abilities.

The Presario's sculpted mini-tower is attractive, but it can't be opened without a screwdriver and offers little room for expansion (one PCI slot and two open drive bays). A slightly obtrusive door in the front of the machine affords access to the Zip and DVD drives, and a second front door covers a convenient set of USB and FireWire ports. A second set of such ports is available in the rear of the machine.

The system comes preloaded with a slick Internet access wizard and includes a Compaq Max Digital modem (which will provide faster online access in the

near future, when G.Lite service is available). The wizard gets you online quickly, providing 50 free hours of Web access through GTE. The machine also includes Compaq's home networking package, recently reviewed in First Looks ("One-Stop Phone-Line Networking," April 6, 1999).

Compaq's service and support is excellent. The machine's warranty lasts only one year (with 90 days of on-site service), but it ships with preloaded restore software and an application for receiving remote support over the Web.

Compaq Presario 5600s. Direct price: \$2,549. Compaq Computer Corp., Houston; 800-345-1518; www.compaq.com.

CYBERMAX ENTHUSIAST 3 DAREDEVIL

Though it lacks many of the slick help tools provided with

consumer PCs from such vendors as Compaq and Gateway, and has slight problems with DVD playback, the CyberMax Enthusiast 3 Daredevil is

one of the more impressive sub-\$2,000 desktops we've seen.

In addition to delivering proficient performance on our tests, it exhibits stirring audio and affords 13GB of hard disk space.

The Enthusiast's physical design is like that of the average consumer PC. Its off-white mini-tower chassis, which can be opened after the removal of thumb screws, offers plenty of room for drive and card expansion and an orderly interior.

The only problem with our test system was that it used two 64MB DIMM modules rather than a single 128MB module. Consequently, you'll have to discard the existing modules if you upgrade to the machine's full memory capacity.

Equipped with Altec Lansing speakers, a subwoofer, and an Aureal sound card, the system affords brilliantly full, clear sound. Unfortunately, during DVD playback (rather choppy to begin with), the system's other functions slow to a crawl. It's difficult even to use the DVD player's control panel.

In addition to a healthy bundle of applications (including Corel's WordPerfect Suite), CyberMax provides a one-sheet setup poster, several standalone hardware manuals, and a warranty of three years for parts and one year for labor. Though the CyberMax Enthusiast 3 Daredevil also offers a 56-Kbps modem, it lacks a customized Internet access wizard and a consolidated user's guide.

CyberMax Enthusiast 3 Daredevil. Direct price: \$1,899. CyberMax Computer Inc., Allentown, PA; 800-443-9868; www.cybermaxpc.com.

BENCHMARK TESTS

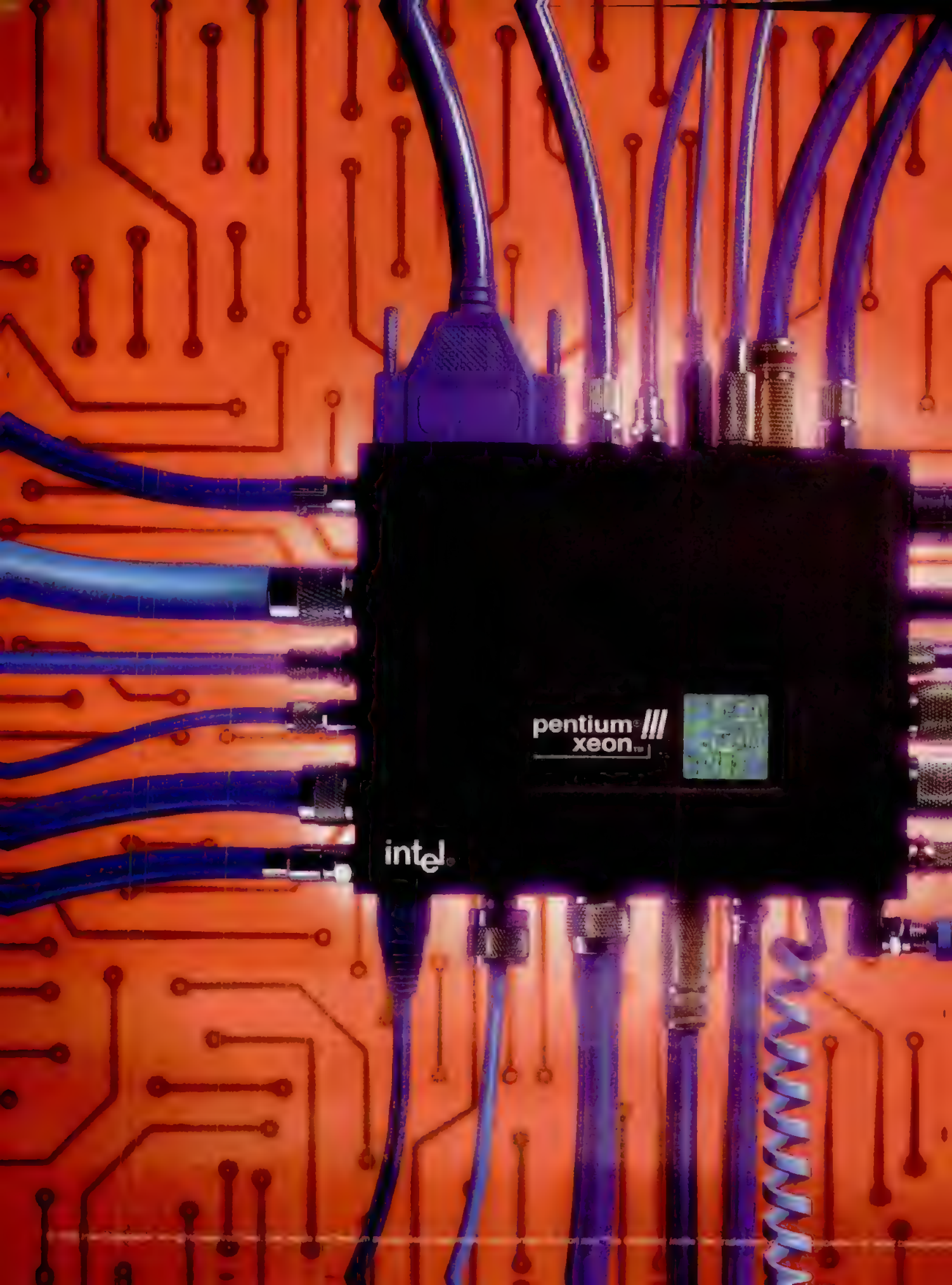
K6-III PCs

Both the Compaq and the CyberMax K6-III machines performed exceedingly well on our 2-D-focused benchmark tests. Both PCs posted Winstone scores comparable to those of previously tested 500-MHz Pentium III machines.

Performance on our 3-D WinMark test suite was another matter, however. Here, the K6 systems scored significantly lower than their Intel-based competition, even though all of the units tested used equally capable graphics boards.

High scores are best.	2D Business Winstone 99	2D 3D WinMark 99	2D Business Graphics WinMark 99	2D CPUmark 99
Bold type denotes first place				
Compaq Presario (K6-III/450)	23.4	570	166	48.8
CyberMax Enthusiast 3 Daredevil (K6-III/450)	24.5	581	187	47.4
CyberMax Enthusiast 3 Daredevil (K6-III/400)*	23.2	554	173	43.2
Average Pentium III/500**	24.7	685	177	38.4
Dell Dimension XPS Pentium III/450**	23.0	771	180	36.1
Dell Dimension XPS Pentium II/450**	22.8	720	158	33.3

* Reported for comparison. ** PC Magazine, March 23, 1999



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Keep In Touch—Online

With discussions and photo albums, eCircles.com helps you stay in touch with family and friends.

By Jim Lynch

Staying in touch online once meant sending e-mail or chatting. But thanks to the explosion of new services that offer an array of useful features for anyone interested in communicating and collaborating via the Web, you can do much more than that. eCircles.com is a free Web service that features discussion forums, photo albums, calendars, file-sharing capabilities, lists, and

registries. You'll find a strong collection of useful features, but there's not much to differentiate eCircles.com from similar offerings found on larger sites.

eCircles.com uses the concept of *circles* to describe the close-knit groups that users can join or create. After starting a circle, a member can invite friends, family members, and colleagues to join the circle.

SMILE: You can create your own photo album by uploading photos and then adding personalized captions.

The discussion forums on eCircles.com are simple and straightforward. Unfortunately,

clunky and slow to use. eCircle.com's photo-album feature fares much better. Users can

easily upload their photos and then add personalized captions to each one.

The service provides an excellent events calendar. Adding events to the



ly, they suffer

from the same problems as most Web-based forums: They lack real threading and are a bit

calendar is simple, and planners can choose to send an e-mail broadcast to all members of the circle, informing them of an event.

eCircles.com provides lists that can be used by any circle member to keep track of books, CDs, to-do items, and just about anything else. Another feature is Gift Registries—eCircles.com's way of adding e-commerce to its service. If you're throwing a bridal shower, for example, you might display the gifts that are appropriate for that occasion. And eCircles.com provides links to participating vendor sites.

Another available feature is file sharing. Members can upload or download any kind of file attachments (up to 125K) to their circles, eliminating the need to deal with e-mail-attachment headaches. This is a useful feature, but we'd like to see the file-size limit increased.

By comparison, Excite and Yahoo! offer similar goodies to much larger audiences, and PlanetAll has more robust personal networking features. If eCircles.com is to prosper in the long run, it will have to find other ways to differentiate itself. Nevertheless, you should give this Web service a look if you're in the market for a way to connect and collaborate with family and friends.

eCircles.com. Price: Free. Requires: Microsoft Internet Explorer or Netscape Navigator. eCircles Inc., San Mateo, CA; 650-577-3900; www.ecircles.com.

Create Web Content

RealPublisher Pro G2 offers great features—as well as some cause for frustration.

By Jan Ozer

Real Networks' RealPublisher Pro G2 (RP Pro) introduces several features that are ideal for high-volume publishers. The program's price (\$499 list) is high for small Web sites, however, and those looking to flex their SMIL creative muscles will be frustrated by RP Pro's structured approach.

RP Pro revolves around three components: a timeline interface, compression templates, and layout templates. The timeline makes it easy to select in and out points for the source media file, and it presents a streamlined environment for batch encoding—both welcome additions.

Compression templates let you create standard output parameters for your media files, simplifying operation for less technical users and ensuring consistent results in high-volume operation. You can access the full range of encoding options, including audio/video bandwidth allocations, audio codec selection, frame rate, and output resolution.

Finally, the layout templates

include ten templates for outputting multiformat SMIL files and four Web page templates for integrating G2 playback into Web pages. You can also add text captions, HTML page turns, and other SMIL events via timeline controls.

Though all templates are basic, they perform valuable functions such as adding logos or advertising graphics to media files, and they dramatically simplify the creation of Web pages with embedded SMIL files. You can add your own templates, though you'll have to build them

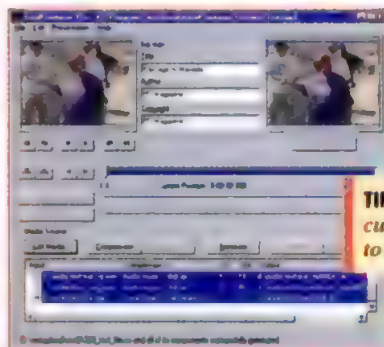
include the ability to preview both SMIL and Web page templates in a browser window and to publish your G2 media files and HTML pages automatically to a Web site.

On the whole, the program works well, presenting a simple and structured production flow—with some exceptions. For example, RP Pro can't scale to aspect ratios different than the original input file, so it creates an output file of unspecified resolution without adequate warning.

These issues don't prevent RP Pro from delivering significant value to a broad range of publishers. At \$499, however, RP Pro isn't an impulse purchase for casual publishers, and

those seeking extensive SMIL creative functionality should look at Digital Renaissance's \$695 T.A.G. Author.

RealPublisher Pro G2. List



TIME IN: The timeline has custom start and stop points, to streamline file encoding.

price: \$499. Requires: 16MB RAM; 8MB hard disk space for program,

500MB hard disk space for data; Microsoft Windows 95, 98, or NT 4.0. RealNetworks Inc., Seattle; 800-632-8920; www.realnetworks.com.

by hand, a complicated task.

Before encoding, a compression "expert" scans all input parameters and warns you of critical errors. Other functions



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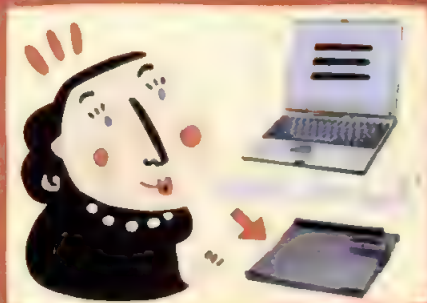




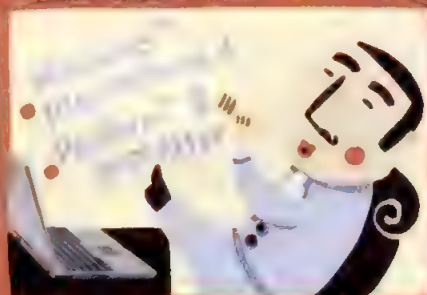
Houston, we have detached the Bay...



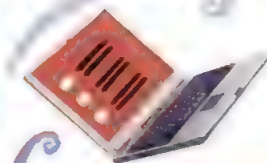
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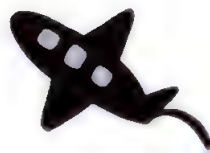
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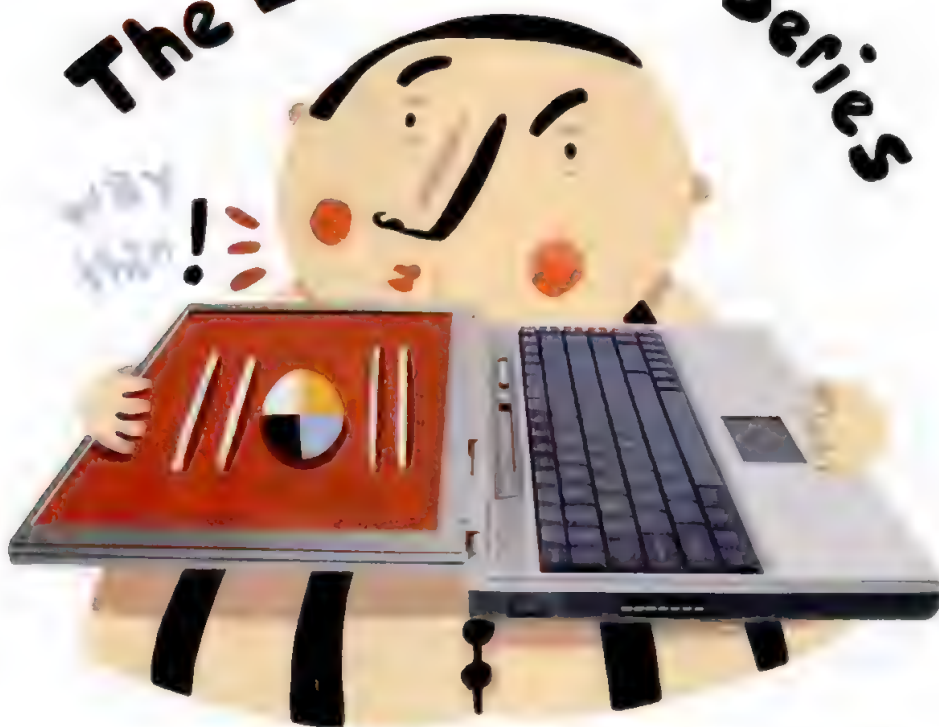


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Expand Your View—for Less

The CTX EX1200 and the EIZO FlexScan T960 make 21-inch monitors newly appealing.

By Alfred Poor

Running out of screen space? Longing for larger windows on your computing world? Hankering for higher resolutions? If you can find the desk room for a 21-inch monitor, you can expand your display horizons. And thanks to CTX International and EIZO Nanao Technologies, your monster monitor may be surprisingly affordable.

Both monitors offer a maximum of UXGA (1,600-by-1,200) resolution, configuration control through a USB connection, 15-pin D-sub and five-BNC connections; and both are priced under \$1,400 (list).

CTX EX1200

The CTX EX1200, from CTX International, comes with a list price of \$1,185 (the street price is under \$900). It uses a traditional Invar shadow mask with 0.26-mm dot pitch and a 20-inch diagonal viewable area.

The monitor is easy to set up. The on-screen configuration menu is fairly typical of digital-control monitors, but it's far easier to use the USB connection to configure. The display driver, which supports the USB connection, includes control features that you can access through the Windows Display Properties screen. You can use either the mouse or keyboard to make on-screen changes for a wide range of settings, including brightness, contrast, position, size, and screen geometry.

We tested the display at SXGA (1,280-by-1,024) resolution using DisplayMate from Sonera Technologies (www.displaymate.com). (PC Magazine uses DisplayMate for configuring, testing, and evaluating display hardware.) The EX1200 did an excellent job with light and dark shades of gray, showed

excellent uniformity, and had a remarkably stable image on the image-regulation tests. The results of the convergence and moiré tests were acceptable at the default settings, but the USB-enabled adjustments made a great improvement.

The monitor was weak on the transient-response screen. On the Video Bandwidth Index (a measure developed by Sonera), it scored 89.0, an acceptable score. There were some faint halo effects and noticeable streaking on high contrast patterns, but these were minor issues.

The company backs the monitor with a three-year warranty (two years on the CRT). The unit also has four powered downstream USB ports in case you want to connect other devices.

Anyone who has been thinking about buying a large monitor will get a bargain with the CTX EX1200 and its premium image quality.

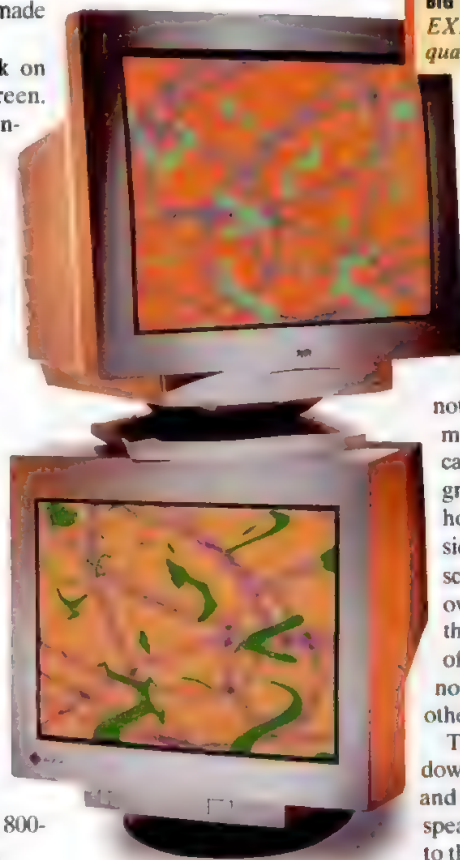
CTX EX1200. List price: \$1,185. CTX International Inc., City of Industry, CA; 800-888-9052; www.ctxintl.com.

EIZO FLEXSCAN T960

The EIZO FlexScan T960 costs a bit more than the CTX EX1200, with a street price of \$1,370, but you definitely get more for the extra money.

The monitor has a 19.6-inch diagonal viewable area and uses a Sony Trinitron tube with an aperture grill, so the glass face is flat in the vertical dimension and curved only in the horizontal direction. Along with special antiglare coating, this makes the monitor less susceptible to reflected glare, which can be more of a problem with larger displays.

The tube has a variable stripe pitch, ranging from 0.25 mm in the center of the display to 0.27 mm at the sides. This is effectively a bit coarser than the EX1200's shadow mask, but the EX1200 is designed to handle UXGA resolutions, and the difference in dot pitch was not a noticeable factor on our tests.



no moiré pattern problems, and the Video Bandwidth Index score was a perfect 100, with no telltale signs of overdriving the beam (a performance-boosting practice that would introduce other flaws). There were some minor screen-geometry flaws that were easy to correct using ScreenManager. Colors ap-

BIG BARGAIN: The CTX EX1200 delivers great image quality at a low price.

peared accurate, and there were no color-tracking problems.

We saw a few minor blemishes, such as a tiny amount of bounce on the image-size-regulation test, some faint halo effects, and a little streaking on high-contrast images. The most noticeable glitch was more a matter of personal taste: Because of the unit's aperture-grill design, there are two horizontal tension wires inside the tube. On a white screen, these cast faint shadows about one third from the top and from the bottom of the screen. Some people notice these shadows, while others do not.

The monitor includes four downstream USB connectors, and you can get an optional speaker attachment that clips to the bottom of the monitor.

EIZO backs the FlexScan T960 with a three-year warranty, including the CRT.

Even though the EIZO FlexScan T960 is priced near the top range of monitors in its class, its cost is far lower than those less-capable 21-inch monitors of just a few years ago. If you want a no-compromise monitor with a big picture at an affordable price, the EIZO FlexScan T960 is an excellent choice.

EIZO FlexScan T960. Street price: \$1,370. EIZO Nanao Technologies Inc., Cypress, CA; 800-800-5202; www.eizo.com.

PICTURE THIS: The EIZO FlexScan T960 has a raft of fine features at an affordable cost.

The included USB ScreenManager software provides more sophisticated control than the EX1200's driver, making the EIZO monitor even easier to set up and adjust. Convergence was only fair, but with ScreenManager we were easily able to improve it dramatically; the monitor has 256-zone digital convergence.

The FlexScan T960 was an excellent performer on our tests. Images were uniform, there were



Nokia 446Xs



OUR ENGINEERS WERE GOING FOR A LINE-OF-SIGHT 35° BELOW EYE LEVEL.



OUR DESIGNERS WERE GOING FOR *swoopy*.

Despite their differences, vocabulary being the most obvious, the engineers and designers at Nokia are all focused on the same thing. Namely, to build the world's best monitors.

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The Nokia 446Xs is a perfect example. This sleek 19" monitor (17.8" VIS) delivers up to 1280 x 1024 resolution, up to 90Hz refresh rate at 1280 x 1024, with a .22mm horizontal dot pitch. It's a compact CRT for a smaller footprint, but it saves considerably more than desk space.

Research shows that traditional viewing angles require your eyelids to be more open, allowing more light into the eye, causing dry eye and fatigue. We corrected this problem by designing the Nokia 446Xs for an optimum viewing angle of 35° (similar to the angle at which you naturally look down at your desk). Its profile helps users experience less fatigue, not only in

the way they sit, but also in the way they think. For more information, visit nokia.com/americas.

NOKIA
CONNECTING PEOPLE

Totally Java Development

Symantec's VisualCafe 3.0a is a powerful tool for corporate developers, with JFC/Swing support.

By Richard V. Dragan

Combining new database features with unprecedented JFC/Swing support, Symantec's VisualCafe, Version 3.0a Database Edition (\$799 list) raises the ease-of-use bar for "100 percent pure" Java development tools. You may need more memory to run this release of the product, but the package is a worthwhile upgrade for users of previous versions and a tempting choice for serious Java developers.

Developers will appreciate the rich array of over 200 components, including Advanced Window Toolkit (AWT), JavaBeans, and Swing. Using VisualCafe, Java interfaces can be just as sophisticated as native-style interfaces written for Unix or Windows.

GETTING INTO THE SWING

Putting database power into the hands of the corporate developer is a strong emphasis of this release. Using the beefed-up database project wizard, we were able to connect to a remote data source, select columns, and create a full-featured Swing applet or application in just a few minutes.

The wizard-generated form was impressively complete, with a navigation bar and other whiz-bang features such as built-in query-by-example (QBE) capabilities and live data presented in design mode. You can also invoke server-stored procedures using the database project wizard. Symantec has apparently done its homework with JFC/Swing components, which can easily be bound to data sources.

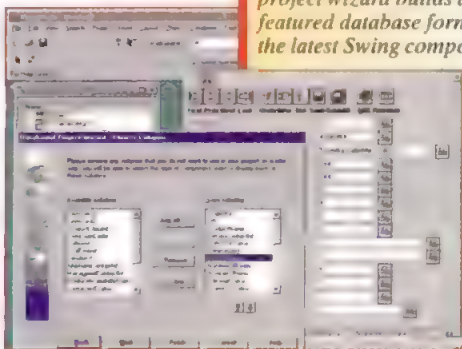
WHY UPGRADE?

For many users, the biggest reason to upgrade will likely be Code Helper. This new feature

automatically lists the methods associated with objects as you type and paste them into your code. The bad news is that Code Helper is not as powerful as the comparable IntelliSense feature in Microsoft's Visual J++ 6.0. Code Helper pastes types for each argument, but it doesn't tell you what the parameters mean. Still, Code Helper is a time-saver.

VisualCafe 3.0a also has new wizards and tools designed to take advantage of advanced Java technologies to write code faster. The JavaBean wizard has been improved so you can create custom JavaBeans more easily. The new servlet wizard automates the process of building Java servlets, which can then be used to generate HTML on

SWINGIN': The new database project wizard builds a full-featured database form using the latest Swing components.



the fly, just like CGI scripts.

The product's Interaction Wizard has also been greatly enhanced in this version. In testing, this feature proved remarkably useful for "wiring together" components. Basically, you can connect components visually and automatically write the code for basic operations (such as selecting a value from a list and placing it in another control). The connected controls are shown on screen, making the Interaction Wizard very useful for RAD-style development.

These wizards, as well as

servlet debugging capabilities, should put this potentially powerful server-side technology into the hands of more developers. As for CORBA and RMI support, the Database Edition of VisualCafe 3.0a still doesn't have much to offer in the way of wizards. The forthcoming Enterprise Edition of the product should include these capabilities, as well as the IONA and Visigenic ORBs.

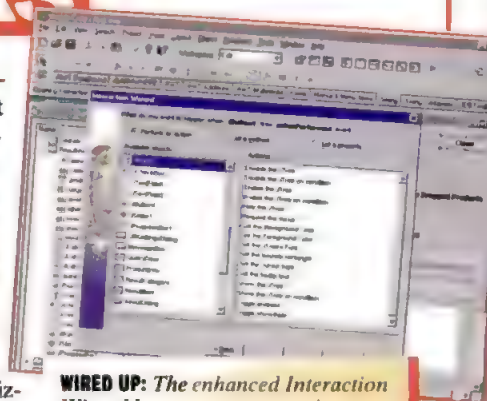
The penalty for these new conveniences is slightly increased hardware requirements—especially on the memory front. Although 64MB is the stated minimum, we experienced downright sluggish performance with that much memory on a 200-MHz Pentium machine running Windows NT 4.0. With more memory, however, the tool is a capable performer.

OPTIMIZED PERFORMANCE

As for Java performance, VisualCafe 3.0a measures up to the Symantec just-in-time compiler (now licensed by both Netscape and Sun) for JDK 1.1.7a. But VisualCafe 3.0a is smarter in other ways with respect to performance. Its native code-generation feature (which compiles Java into native x86) is now better optimized, and it supports Pentium II.

A big advantage is that you can now plug different versions of JDK (from 1.1 through the new Java 2) into VisualCafe. Though we found this process to be a bit tricky, we were able to compile successfully to both JDK 1.1.5 and Java 2 executables.

One of the biggest hurdles in Java usage today is de-



WIRED UP: The enhanced Interaction Wizard lets programmers wire components together and automatically writes code for simple event handling.

Besides permitting debugging under Netscape 4.5 and Microsoft Internet Explorer 4.x, the new VisualCafe 3.0a also steps up its deployment wizard, which now automatically creates JAR files on a remote server via FTP. Better yet, as you develop custom JavaBeans (which are necessarily placed in JAR files), the environment automatically reloads them into its design environment.

For team development, VisualCafe 3.0a comes ready for today's popular version-control programs. A single-user version of StarBase Versions is bundled. Other tools that accompany the Database Edition include Symantec's own dbAnywhere middleware server (with unlimited licenses) and Oracle Lite, a working SQL server for the back end. Visual Page 2.0, Symantec's HTML editor, rounds out the package.

Right out of the box, VisualCafe 3.0a Database Edition mixes a variety of features that will let the department programmer get more out of Java. Though not a specifically enterprise-focused product, the package stands as a solid, Swing-centered, and slick productivity tool.

VisualCafe, Version 3.0a Database Edition, List Price \$799, Symantec Corp., 3400 Hillview Ave., Redwood City, CA 94061. (650) 996-0000. www.symantec.com



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Not Just Chat Anymore

AOL has turned ICQ into a desktop portal, with a calendar, search, and sticky notes.

By Jim Lynch

With more than 28 million users, ICQ has clearly taken the Internet by storm. ICQ was recently acquired by America Online: In ICQ 99a Beta, Version 2.13, AOL has preserved the original ICQ look and feel while adding a slew of new features.

New goodies (all free) go beyond instant messaging. You can send greeting cards to other ICQ users, create home pages, send voice messages, forward ICQ messages via e-mail, search the Web, use sticky notes, and more.

With its new search feature, ICQ has become a desktop portal, eliminating the need for a user to visit a separate search engine. ICQ's search feature is powered by Inktomi Corp., the same company that provides search technology to Yahoo! and other major portals. If you wish to use a different search engine

than ICQ's, you'll find built-in links to 17 search engines. We just typed in the word we wanted to search for and then clicked on our search engine of choice. ICQ opened our browser and displayed the results.

ICQ also has built-in links to news, weather, software, Usenet archives, general reference, and finance information. Between these links and the new search functionality, finding information was extremely easy.

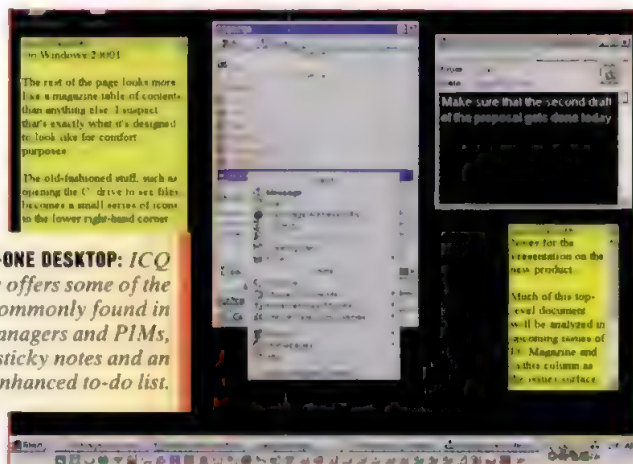
But ICQ hasn't lost touch with its core functionality and purpose—instant messaging and chat. New features include the ability to change text color and font size in messages. You can also now use Emotions and Actions (expressive words, graphics, and sounds) as you chat, and you can save your

chat session for playback at a later time.

ICQ has also added or bulked up features that have generally had their roots in more traditional contact managers. You'll find a

the leader, it's got some serious competition coming up from behind. Yahoo! has begun beefing up its own chat pager by adding search capabilities and tight integration with its portal, includ-

ALL-IN-ONE DESKTOP: ICQ now offers some of the features commonly found in contact managers and PIMs, including sticky notes and an enhanced to-do list.



to-do list, sound schemes, voice messaging, and enhanced e-mail functionality. And users can now leave themselves notes on their own computer screens. This is a handy addition for those of us who have buried our monitors under yellow sticky notes.

Although ICQ is clearly still

ing news stories, sports, and a calendar. If ICQ is going to remain the leader, AOL will have to keep a blistering pace in adding features.

ICQ 99a Beta, Version 2.13. Price: Free download. America Online Inc., Dulles, VA; +972-3-6488090; www.icq.com.

Image Uploads by USB

The Antec PhotoChute 3 USB universal card reader supports fast, two-way digital image transfer.

By Bruce Brown

Digital camera users impatient with slow image uploads via serial cables can truly rejoice in the 1.5-MBps rated transfer speed of the Antec PhotoChute 3 USB universal

ATA Flash PC Cards. The primary purpose is for transferring digital image files, but you can also use PhotoChute to move any files stored on the supported media.

NO WAITING: The PhotoChute 3 uploads digital camera images in seconds.

Installation is quick and easy. You install the

PhotoChute 3 USB drivers, connect the device to a USB port, and in less than a minute, the computer links the drivers to the hardware and records two removable-disk icons in its directory.

The PhotoChute looks like an overgrown computer mouse, weighing 4.6 ounces and measuring 0.9 by 3.3 by 4.8 inch-

es (HWD). The device has two card slots, one for SmartMedia and one for ATA Flash PC Cards; a PC Card adapter with a slot for a Type I Compact Flash card is also included.

Files stored on cards in the PhotoChute's slots can be accessed from one of the two directories in Windows Explorer or from My Computer. From either one you can access, delete, move, or copy files to your PC's hard disk. You can also move files from your PC to the removable media in the PhotoChute.

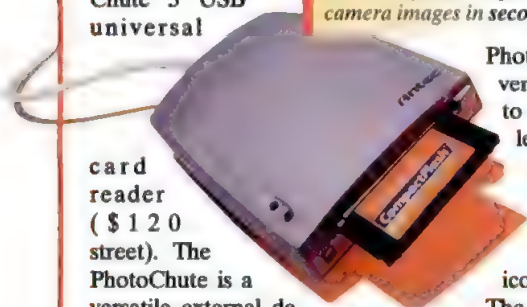
Convenience is a big draw for the PhotoChute, but transfer speed is an even greater benefit. On our test, 24 JPEG files totaling 7MB stored on a 8MB Compact Flash Card took 16 minutes 55 seconds to transfer via serial cable; using the PhotoChute, the same transfer took only 41 seconds. Both transfers were done in Windows 98, using Win-

dows Explorer's copy function.

If you want to move files from one media type to another within the PhotoChute, you can't do so directly. To make such a transfer you have to move the files from one of the PhotoChute's slots to your PC's hard disk, and then you must move them back to the other external media slot.

The Antec PhotoChute 3 USB universal card reader is an obvious choice for speeding up digital image transfer from your camera to a PC or between cameras. Portability, quick installation, ease of use, speed, and media flexibility all are in its favor.

Antec PhotoChute 3 USB. Street price: \$120. Requires: Microsoft Windows 95 OSR2 (with USB supplement), 98, or NT 4.0 or later. Antec Inc., Fremont, CA; 888-542-6832, 510-770-1200; www.antec-inc.com.



card reader (\$120 street). The PhotoChute is a versatile external device for reading and writing files to and from Compact Flash, SmartMedia, and Type I and II

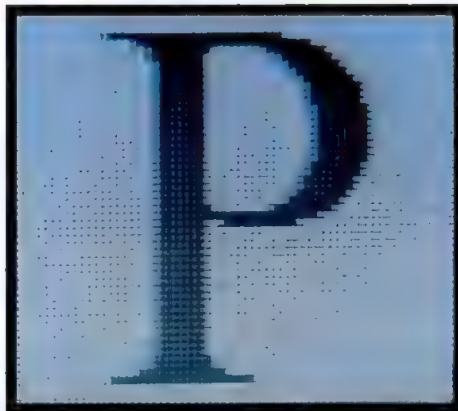
IT'S A FACT – DIGITAL IS BETTER

Princeton DPP550™

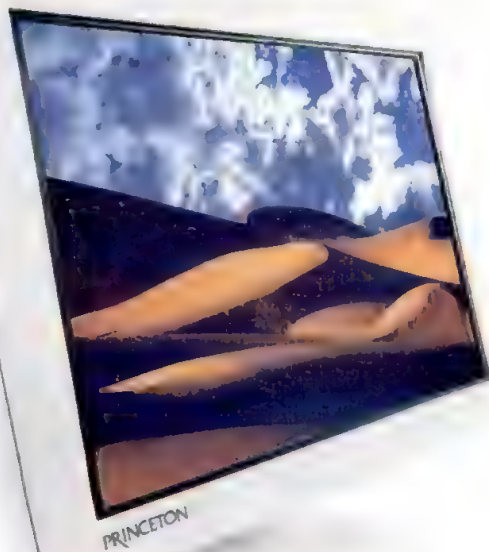


(Unretouched photo) - crisp geometry, noise-free, sharp edges, clear fonts, pixel perfect

Leading Competitor's Analog



(Unretouched photo) - distorted image, analog noise, blurred images, muddy text, lost data



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BackWeb Keeps Pushing

BackWeb 5.0 aims to distribute content over your network, but for some, it may miss the mark.

By Robert P. Lipschutz

BackWeb gives a Headline News or Bloomberg television feel to your desktop, but unlike Internet portals such as Yahoo!, it focuses on disseminating internal company content such as files or Web site blurbs. Although the need for a corporate information portal is real, BackWeb 5.0 (\$38,000 list for a 200-seat license) may miss the mark for many corporations.

The BackWeb solution is hindered by the lack of flexible and easy-to-use content publishing and capture techniques, as well as the lack of an effective user and group model. Unfortunately, this version's new features, such as authentication and encryption, upstream publishing, and NeighborCast, don't fix these fundamental problems.

A separate product, BackWeb Sales Accelerator, targets your sales and marketing staff and greatly improves on some of the publishing problems found in the server component, called the BackWeb Foundation. BackWeb appears to be in transition, as many of the good features found in the Sales Accelerator are not found in the Foundation product reviewed here.

RECEIVING CONTENT

We like BackWeb's content organization and the eye-catching notification mechanisms such as an information ticker. The BackWeb InfoCenter client is used to subscribe to channels, view content, and configure other aspects of the BackWeb desktop. Special notifications, or *Flashes*, pop up on the desktop to announce the arrival of new information.

Content items are organized into channels; a title, summary,

and full story describe each. The full story can also be more than just a piece of text: HTML files, Microsoft Office files, and multimedia content, among other things, can be used, as long as they are addressable through a URL.

BackWeb has made strides on the security side, with the addition of server-side certificates. Since BackWeb is not Web server-based, it didn't get Secure Sockets Layer (SSL) for

DO IT YOURSELF: The Publishing Wizard Pro is the main tool provided for end-user publishing.

free. Instead, BackWeb has added its own means of digitally encrypting content. This means that channels can be encrypted between the BackWeb Foundation and client, thereby protecting sensitive information.

BackWeb still does not have a good access control or targeting model, however. Administrators must prepare separate BackWeb clients for users based on which content they are allowed to see. This problem is being addressed for future versions and has already been addressed in Sales Accelerator.

PRODUCING CONTENT

Of course, BackWeb content isn't created magically. There are both manual and automated ways to produce or capture this

content, and someone or some group will need to do it.

For manual content production, the BackWeb Foundation includes the Publishing Wizard Pro and its BALI editor. With the Publishing Wizard, authorized users can publish information to a single BackWeb channel. A user can start with the included templates or can build custom Flash templates using

BackWeb tools are available for creating what the company calls hooks and automations to existing content sources. For example, we used BackWeb's channel profiler tool to extract information from Web sites into BackWeb-accessible channels. A different tool—the channel replicator—is used for updating files; a separate server API exists for other kinds of integrations.

PUSHY CLIENT

The BackWeb client can offend some network administrators. BackWeb can communicate using UDP

BROWSE: The BackWeb InfoCenter client shows content items organized into channels and categories.

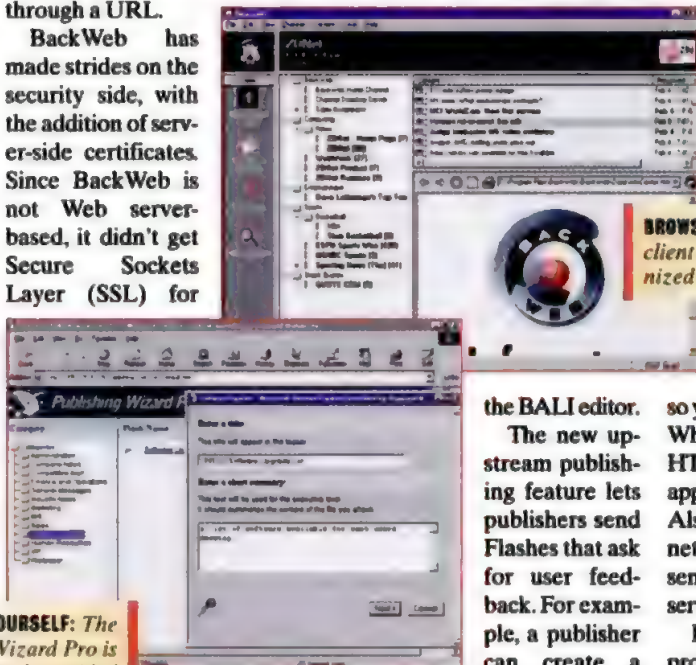
or HTTP, but many companies don't let UDP traffic through their firewall,

so you'll need to resort to HTTP. When the BackWeb client uses HTTP, it can compete with other applications for processor cycles. Also, BackWeb takes its toll on network bandwidth, because it sends a lot of information from server to client.

BackWeb has addressed these problems with various components, including proxy servers, NeighborCast, and IP multicast. BackWeb proxy servers can decrease traffic between clients and the BackWeb server, and can increase client response times, by caching content locally on the network. NeighborCast, a new feature, reduces traffic by allowing PCs on the same network to proxy content to other clients, which is similar to having a set of distributed proxy servers.

BackWeb should be carefully evaluated before deployment, because it requires a lot of technically demanding customization work to push out your corporate information.

BackWeb 5.0. List price: \$190 per seat (minimum 200 seats or \$38,000). BackWeb Technologies Inc., San Jose, CA; 800-863-0100; www.backweb.com.



the BALI editor.

The new upstream publishing feature lets publishers send Flashes that ask for user feedback. For example, a publisher can create a form that a user fills out and then sends back to the server. Creating these "two-way" communications does require someone technically savvy, however.

AUTOMATING THE PROCESS

Most BackWeb content is captured automatically, with BackWeb playing the role of information middleman. For instance, the information may already exist in a Web site, database, file system, or other application, and BackWeb simply needs to extract it and feed it to users.

But BackWeb has a bewildering set of tools and APIs for capturing content. Extracting information from disparate sources can be a complicated process that requires a lot of programming. Numerous

Keep Tabs on Your Clients

The Intel PRO/100+ Management Adapter's new features let you better manage PCs on your LAN.

By Steve Rigney

A network administrator can check on client PCs in dozens of ways. Unfortunately, most of these methods require installing some kind of remote control or SNMP agent on each client. This method may not work if the client is off or cannot boot. Thus, one of the best ways to manage your client PCs is via a hardware device such as the new Intel PRO/100+ Management Adapter network card (\$99 list). This 10/100-Mbps auto-sensing adapter includes its own processor for increased performance, as well as management features such as Wake on LAN (WOL), Wired for Management (WfM),

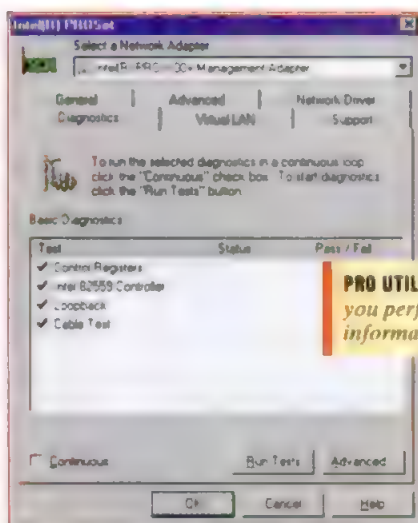
a copy of LANDesk Client Manager, and support for the Desktop Management Interface (DMI) specification.

The PRO costs a little more

than most PCI 10/100-Mbps NICs, but its management abilities and performance make it worth the price. The adapter is as easy to install as any other

PCI adapter and includes drivers for most major OSs, including Windows 9x, Windows NT, and NetWare. The PRO also works with new Ethernet features such as VLANs and 802.1p prioritization.

A useful feature of the



PRO UTILITY: The PROSet applet lets you perform diagnostics and gather information about the PRO.

PRO is the Boot Agent, which lets you configure the NIC to boot from the local hard disk or from the network. If you select from the network, the Boot Agent will receive an image from a network management console. This image can boot the system with its existing OS or send a command to up-

date the PC to a new OS. The Boot Agent is also secure and will verify the boot server before it accepts any commands.

The package also includes a utility called PROSet, which is a control panel applet that provides all kinds of information about your NIC. For example, you can run diagnostics, set up a Virtual LAN, monitor traffic, and tweak performance options.

Though network adapters are only one of the hardware devices that LANDesk Client Manager can report on, we still think it is a helpful value-add for this package. LANDesk is easy to use and allows you to determine the health of your PC, including memory, disk drives, system board, and network.

Intel PRO/100+ Management Adapter. List price: \$99. Intel Corp., Personal Computer Enhancement Division, Hillsboro, OR; 800-628-8686; www.intel.com.

Air Out Your Network

ZoomAir PC Wireless products work together to create an easy, inexpensive wireless office solution.

By Jeffrey Wit

ZoomTelephonics' ZoomAir Wireless Networking family of products may not break any new ground in terms of market focus, but the line's 802.11 standard-compliant adapter cards and Access Point Software bring to the party a price roughly half that of the competition. Smaller shops looking to reduce costs by sharing Internet access can also benefit from the bundled SyberGen SyGate software, which allows shared analog, cable, and xDSL connections.

The ZoomAir wireless adapters—the PC Card NIC 4000 and the ISA NIC 4005 (\$299 each, list)—let you create a peer-to-peer network, or they can serve as an adjunct to a wired Ethernet LAN. The latter is accomplished by the bridging

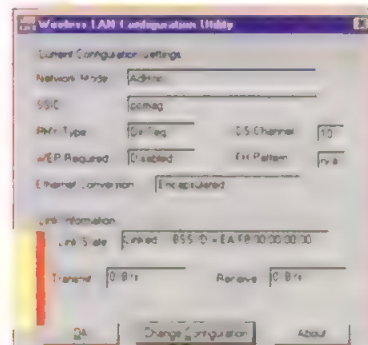
function of the Access Point Software 4010 (\$199 list). Both adapters are actually the same radio products, in that the ISA NIC 4005 acts as a host card for adding PC Card slots to your desktop, with a back slot for accommodating the PC Card NIC. Both cards run with any flavor of Microsoft Windows, operate on the 2.4-GHz frequency, use Direct Sequence Spread Spectrum (DSSS) technology, and claim a performance rate of 2 Mbps.

EASY SETUP: The Wireless LAN Configuration utility simplifies management monitoring.

Configuring the PC Card caused us some DLL file errors, and we had to fiddle with Windows 95's Hardware Devices resources to make the ISA NIC share the desktop with our Intel PRO/100B card.

Once the system is operational, the ZoomAir hardware is easy to manage and manipulate with its Wireless LAN Configuration utility. The tool allows the setting of operational modes and traffic statistics. LEDs on the adapters show power, network connection, and data transfer.

Zoom touts ranges of 1,000 feet in an open space and 300



feet for indoor environments. Each unit uses a fixed antenna, however, that protrudes a couple of inches from the card and gives you little relief from object interference. Despite this drawback,

we didn't have problems with simple file transfers performed with a microwave oven and a 2.4-GHz cordless phone nearby. The addition of the Access Point software effectively increases your range, and with multiple installations, it will allow roaming without interruption.

The SyGate software was easy to install and use. We shared our dial-up link concurrently between our laptop, Ethernet-wired, and Access Point desktop. There is no configuration needed on any client's browser, and the connection is protected by a built-in firewall.

Besides some configuration glitches, we found the ZoomAir system to be attractive and affordable.

ZoomAir Wireless Networking PC Card NIC 4000. List price: \$299. **ZoomAir ISA NIC 4005.** List price: \$299. **Access Point Software 4010.** List price: \$199. ZoomTelephonics, Boston; 617-423-1072; www.zoomtel.com.

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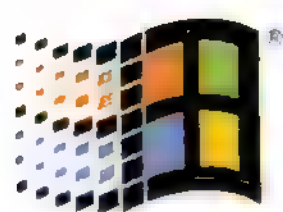
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Microsoft Windows NT Workstation 4.0 is now available with Service Pack 4, which includes Y2K and Euro updates. For Year 2000 information regarding Microsoft products see www.microsoft.com/year2000/.

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Making Mail Service More Successful

Rockliffe Systems' MailSite 3.1 SQL Enterprise combines an e-mail server with database tools to create better mail service.

By Les Freed

Rockliffe Systems' MailSite 3.1 SQL Enterprise (\$1,995 list) combines first-rate IMAP4, POP3, and SMTP mail server functions with a full-featured, easy-to-use mailing list server.

As the name hints, MailSite 3.1 SQL Enterprise includes tools to integrate data from SQL server databases. You can use the SQL hooks to extract user names or mailing list information from a database. You can also extract data from a SQL database, merge the data into a text message, and then automatically distribute the message to a group of users.

We found the program very easy to install and operate. MailSite's help file provides an easy-to-follow checklist of things to do; we simply

MailSite's configuration features. Fortunately, you can run the native Windows MailSite Console program from any PC on the LAN, and you can manage multiple MailSite servers from one copy of the Management Console.

As with any mail server, you must create a list of user accounts before your system is ready to send and receive mail. When you install MailSite on a Windows NT system, the program can import user list information from the Windows NT user list. This lets you quickly create mail accounts for all

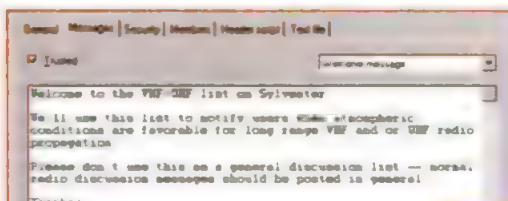
for about a dozen e-mail clients.

The MailSite mail server's laundry list of features includes auto-reply, user-definable vacation messages with optional mail forwarding, secure log on, mail hosting for multiple domains, and scheduled delivery. MailSite lets nonadministrative users change their own mailbox settings using the HTTP or Java interfaces or send a specially

Like all mailing list managers, MailSite provides a collaborative two-way e-mail discussion forum to create a service similar to an NNTP discussion or groupware discussion forum without separate servers or clients.

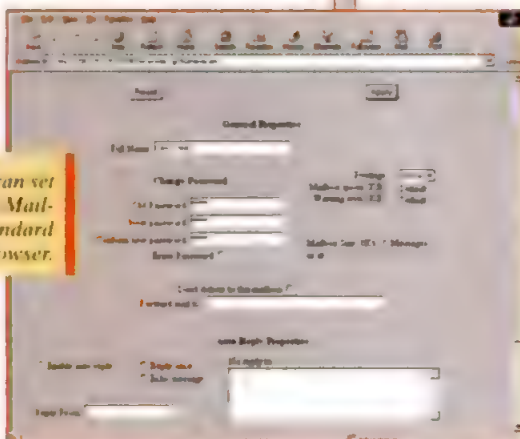
To use the Mailing List server, you create lists (groups of users), and you assign each list its own e-mail address. MailSite relays mail addressed to the list's address to all members of the list. A single server can host multiple lists, and users can belong to any number of lists.

Administrators can place users in lists, but users can add and remove themselves from a list by sending special control messages to the server.



NEW DISCUSSION BOARDS:

MailSite can aid collaboration by creating two-way e-mail forums or group discussion forums without a separate server or clients.



HTTP CONSOLE: You can set rights and configure Mail-Server from any standard Web browser.

followed the numbered steps to get our MailSite server up and running. No reboot is required—an important factor if you'll be running MailSite on a Windows NT Server machine that is also being used to provide file, print, or SQL services to a network.

MAIL—YOUR WAY

MailSite provides several ways to configure the mail server. You can use the MailSite Console, a Windows program that resembles the Microsoft Management Console, or you can use MailSite's HTTP and Java management consoles from any Web browser. The Java interface is more complete than the HTTP interface, but neither one provides full access to all of

the users on your LAN. MailSite can also obtain user list information from a SQL database, or you can manually create user accounts using the HTTP or MailSite Console interfaces.

MailSite's e-mail server provides connectivity for just about any type of e-mail client, using Internet-standard POP3 and IMAP4 protocols. We tested MailSite with Forte Agent, Microsoft's Outlook and Outlook Express, and Netscape Communicator 4.5 e-mail clients, and encountered no problems. The MailSite manual includes detailed configuration instructions

formatted e-mail message to their own account. This feature gives users the ability to change their passwords, auto-forward messages, create a vacation message, and specify auto-reply settings, saving wear and tear on the mail system administrator.

ELIMINATE SYSTEM SPAM

System administrators will also appreciate MailSite's antispam features. Incoming messages are checked against a spam blacklist. If you wish, you can limit outbound SMTP messages to the local LAN, preventing spammers from relaying mail through your server. A reverse-DNS lookup verifies outbound message addressing, preventing users from sending messages with a forged "From" address.

MailSite's Mailing List manager is equally full-featured.

Mailing lists can be moderated, so that all incoming messages must be cleared through a manager before they are forwarded on to the rest of the group. MailSite provides browser-based moderation, allowing list administrators to manage their mailing lists from any browser.

A free 30-day trial version of MailSite is available from the company's Web site. It supports unlimited mailing lists and unlimited users. If you like what MailSite has to offer but are put off by the price, Rockliffe has other versions of MailSite, starting as low as \$145 for a 10-user package. Rockliffe provides 30 days of free technical support with all versions MailSite, and ongoing support contracts (including software updates) are available for a fee.

MailSite 3.1 SQL Enterprise. List price: \$1,995. Rockliffe Systems Inc., Santa Clara, CA; 408-554-0766; www.rockliffe.com.

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Mixed Reactions on WinFax

By Alfred Poor

Our positive review of Symantec's WinFax PRO 9.0 ("Feature-Rich WinFax, October 20, 1998) left some readers nodding their heads in agreement but prompted others to call for our heads on a platter. What could lead to such divergent views?

On the plus side, WinFax PRO 9.0 continues to do many tasks well. You can print to a fax modem as easily as you can to a printer. You can store attachments that you can add to a fax, as well as maintain multiple phone books for fax recipients. The program lets you use one of

the many stock cover pages included with the program, or you can quickly create your own.

One attractive feature of this version is that it lets you fill in the text message portion of a cover sheet right in the preview mode of the Message Manager program; you don't need to open a separate viewer or editing utility. Though we have encountered some problems in using the program, we remain positive about the product.

On the downside, the package is admittedly a resource hog. The Controller module (plus a fax modem driver) takes up about 2.5MB of RAM. Load the Mes-



OVERLOAD: WinFax PRO 9.0 will report on whether or not your PC has sufficient memory to run a program.

sage Manager and the memory use increases by another 5.8MB.

If you're not sure whether you have sufficient memory for the

program, WinFax PRO 9.0 can help. Launch Message Manager, choose the Help command, and then select About Message Manager. By choosing the System Info tab and then clicking on Memory Status, the program will indicate how much physical memory is available.

A shortage of memory could explain many of the reader complaints. These include slow performance, unpredictable fonts on printed cover

pages, unreliable automatic launches from applications such as Microsoft Word, and a few system crashes.

We found that when using WinFax within applications on systems with low memory, it is best to launch Message Manager (and Controller) first and then use the WinFax print driver within the application's standard Print facility, rather than relying on any macros or special menu commands. Additional memory would probably be a better long-term solution for these problems.

More memory won't make a difference with the complaints about Symantec's technical support, however, which we heard from numerous people.

Reexamining the ImageDeck

By Bruce Brown and Carol Venezia

After our recent First Looks review of Microtek Lab's ImageDeck scanning appliance ("Scanning sans PC," January 19, 1999),

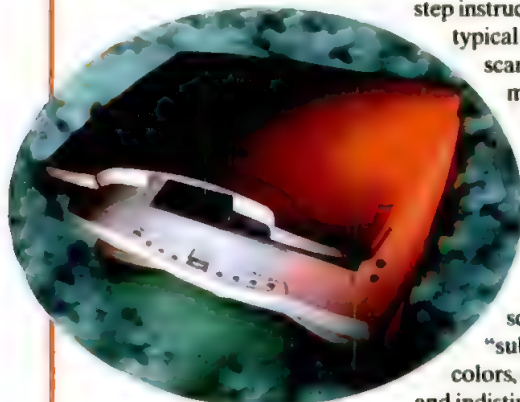
skippy; what we were looking at was a copy of in-process instructions. The final documentation that shipped with the system was actually a 29-page manual, with detailed illustrations of system components, as well as step-by-step instructions for performing

typical tasks such as how to scan and save a document. But in our opinion, the listing of what LED status messages mean was still incomplete in the final documentation.

Also, we described scan quality as "subpar, with muddy colors, darkened midtones, and indistinct details." To retest, we printed a full-page photo from a Kodak DC260 digital camera on an Epson Stylus Photo EX printer (the same type of printer used in our original testing). Then we scanned that print with the ImageDeck and printed the image again on the Epson Stylus Photo printer. We found this print to be virtually indistinguishable from the original print, which indicates a very high-quality scan.

we found out that the system we received for testing was actually a preproduction unit. Because some of the issues that we had with the system could have been—or actually were—due to the fact that the machine was indeed not completely finished when we tested it, we decided to take a second look at a production-level machine.

In our review, we classified the ImageDeck's documentation as



Finally, we feel that we wrongly overemphasized the scanning component of the system by suggesting that one-touch scanners could do the same job as the ImageDeck. The ImageDeck is not intended to be just a scanner—but a scanning appliance that's aimed at users (not PC phobes, as we stated earlier) wanting convenience, space optimization, and ease of use.

And in practice in a home office, we found the device to be easy to set up and very convenient to use.

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Tell us what you think...How do you like the new products you're using? Second Looks is your forum for feedback. Join us online to tell us about your experiences. We discuss a different new product each week and summarize your comments here. Below are some of your comments from our discussion of WinFax PRO.

I have given up on WinFax PRO. I can't believe any reputable software company would release a product with so many bugs! I can't believe the company's tech support is even mentioning the idea of reinstalling Windows as a solution. I wonder if they have WinFax PRO installed on their systems and do they reinstall Windows every time it locks up??

—Al Cook

WinFax PRO is the type of software that gets my blood boiling. The program is so slow—even on the fastest of PCs. It is such a resource hog that using it as a "communications center" on anything other than a dedicated PC is inconceivable. WinFax PRO has too many so-called features, but the crucial everyday type of functionality either doesn't work or isn't well designed.

—Christian de la Pointe

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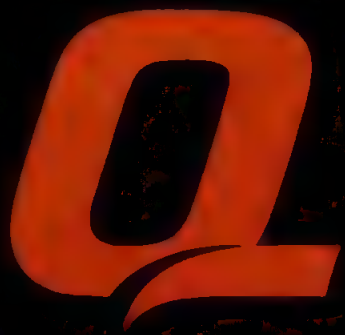
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The Kids Are All Right!

Where were you on National Inventors' Day? I was standing before 60 fourth-graders at a local elementary school, talking about inventions and technology. It was by far the youngest group I'd ever addressed, and I was worried that I might go over their heads or find a general lack of interest on their part.

I started by asking them, "What's an invention?" We worked up a good definition, and then I asked, "What's the greatest invention?" When we were done, their list coincided rather closely with mine and included the light bulb, radio, television, and telephone. Their list included a few things that weren't on mine, such as the Sony Playstation and the Nintendo 64, but we came to agree that game machines were outgrowths of the same microprocessor and display technologies that were behind personal computers.

I showed them a brief animation from the CD-ROM included in Ron White's excellent book *How Computers Work* that illustrated the operation of a cathode ray tube. We then talked about the huge number of inventions that had to precede the CRT, such as glassmaking, glassblowing, vacuum pumps, metallurgical innovations, electromagnets, casting and coating techniques, electronics, and more. Then we talked about other kinds of displays, such as the liquid crystal in my laptop or the digital light processor (DLP) chip in the InFocus projector I was using.

We had a great time with the "let's invent something" segment. Among the ideas they offered up were a solar-powered car with a light on the top so it could run at night, a time machine, clothes that change themselves, a cloaking device/personal armor, and a self-recharging battery. As the boy explained, you just press a button and it recharges itself. I jotted these onto the blackboard so that we could discuss them in turn.

After the kids began to understand efficiency and conversion losses, they quickly decided to abandon the lighted solar panel idea in favor of a car that used solar panels to charge a battery that ran the motor.

Without getting too deep into the laws of the universe, I explained that the conditions under which time travel becomes theoretically possible tend to kill human beings, such as at the event horizons of black holes. I wrote "impossible" next to the item on the board, and the kids razed me roundly insisting that anything's possible. I like that kind of optimism; it's uplifting. Besides, they have urgent applications:

Most wanted to go back in time to undo some mistakes that they'd made or just do their homework. Justice runs strong in a 10-year-old's veins, and a number wanted to change major misdeeds in history.

The kids laughed when a girl suggested "clothes that change themselves," but I asked her if she meant clothes that would jump on and off your body or clothes that could change color and perhaps style. She intended the latter. Together with the boys' suggestion of a cloaking device that also offered invulnerability, this triggered a lively discussion of nanotechnology. Once they got the idea, they could see the possibilities for clothing that could change its color and style, clean itself, warm you, cool you, and potentially protect you. They came to doubt that it would render them invisible, however.

Another girl asked how we can build things that can't even be seen with the naked eye, which launched a side discussion into photomasking and etching, and how it resembles silk screening at a microscopic level.

We didn't get to spend much time on the self-recharging battery, but there's the germ of an idea in there. After all, it's just energy storage. Who's to say that mechanical energy couldn't be made to reverse the battery's chemical reaction, thus restoring the battery? Could the change be stimulated by a pulse from a piezoelectric crystal? Can kinetic energy be stored as chemical energy? After all, nothing's impossible.

My fears about talking to fourth-graders about technology were utterly unfounded. The kids were terrific—even inspiring. The boys were as brash and rambunctious as you'd expect them to be, while the girls' self-confidence was more thoughtful. They showed no trace of the lessened self-esteem that affects so many preadolescent and adolescent girls (required reading: Mary Pipher's *Reviving Ophelia: Saving the Selves of Adolescent Girls*).

I even told them the Thermos-bottle joke, which was the only joke I knew about inventions. You can read it at www.billsbest.com/thermos.html. Most of them got it. The kids are all right. **PC**



My fears about talking to fourth-graders about technology were utterly unfounded.

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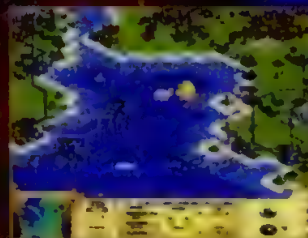
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Microsoft's New Enemies List

Recently I received a copy of one of the many upper-level briefings that executives at Microsoft pass around. Various PR functionaries are known to leak things to certain media people, hoping to get a desired effect. I don't know anyone else who has the presentation, and it's interesting enough to report. It will

be especially interesting to those companies on the latest Microsoft hit list.

The list is a moving target, and this year's is no exception. The title is "Threats," and it targets companies and trends that Microsoft has decided to fight over the next few years. In order, this is the list:

1. AOL.
2. Internet and server-based apps.
3. Java and Jini stealing developers.
4. Alternative PCs: Linux, BeOS, iMac.
5. Stagnation.
6. The service-based business model.

What's interesting about this list is that AOL leads the pack, and Microsoft intends to go after it by redeploying MSN on the desktop with a vengeance. MSN will be the default gateway to the Net and to any AOL-like services. This new scheme (which sounds a lot like the original MSN scheme) should be deployed in the next two years.

As for "Internet and server-based apps," remember that Gates and company have been at the forefront of the PC revolution, and they are never going to let it fall back into a thin-client model. This does not have to be fought against, because powerful desktop machines loaded with apps are natural. Microsoft can't bring itself to think this way. It must fret. Fact is, running the simplest apps from the Net is too painful for most users.

"Java and Jini stealing developers," which is somewhat related to "Internet and server-based apps," is actually about manpower. Ignored in all the commotion is the fact that there are only so many programmers in the world, and if they're sucked into a non-Microsoft camp, then Microsoft is hurt. It's something I have never thought about but understand. Then again, programmers go where the money is. Maybe Microsoft is to blame.

The fourth item is a surprise only because it lists the Apple iMac as a threat. I thought Microsoft and Jobs were suddenly working together again. Apparently not. Of course, Linux is wisely at the beginning

of the list. Linux is a serious threat to Microsoft, and I see no evidence other than this mention that the company has a strategy to deal with it.

"Stagnation" refers to something I've been harping on for the past year or two. The entire industry is stagnating because no new compelling apps have appeared. Microsoft should take part of the blame for this "threat." Perhaps it should put itself on the list. Finally there's "the service-based business model," referring to an Oracle scheme now beginning to surface.

I found it interesting that the DOJ wasn't included as a threat. I guess Microsoft finally got a clue that the government was like death and taxes. Why bother worrying about it?

Microsoft has to deal with these perceived threats while jumping on various bandwagons. As another list reveals, the big trends it plans to address in the next few years are the following: the PC becoming too complex and unreliable, media going digital, homes having more than one digital device, home networking, and relevancy, simplicity, and value coming from the Web.

Exactly how the PC being too complex and unreliable is a "trend" is a mystery. It's a fact, not a trend. The rest of this list is pathetic. It's all rehashed stuff you can get out of a magazine. This list reaffirms the notion that the company is a follower and does best when reacting. It's really a Japanese model of copy and improve, a model that Gates admires. The irony here is that the Microsoft model feeds and grows off the universe of good ideas but tries to crush the mechanisms that create those ideas, thus causing the threat of stagnation. It's an unusually self-destructive mechanism in and of itself.

The fact is, Microsoft is unable to recognize trends as they develop independent of trade reports. And the company sees every development as a "threat," even when it poses none. Getting out of this frame of mind would release Microsoft from the self-imposed, burdensome siege mentality that has stifled creativity in the company as far as I'm concerned. My advice: Put *stagnation* on both lists as the only item, and look in the mirror.



Microsoft intends to go after AOL by redeploying MSN on the desktop with a vengeance.

More on the Web:

Read John C. Dvorak's news, views, and snide asides every Monday at PC Magazine Online. And don't miss Dvorak's "Silicon Spin" every day on ZDTV. You can also view past shows at www.zdvt.com/siliconspin.

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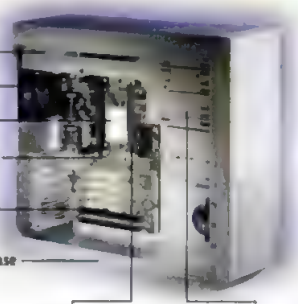
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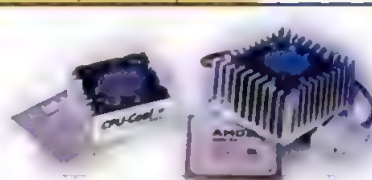
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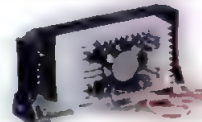
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John C. Dvorak's



INSIDE TRACK

The **most talked-about technology** over the next year will be advanced varieties of fiber-optic transmission, led by Wavelength Division Multiplexing (WDM). WDM is best described as the opposite of what a prism does; various light frequencies are used to carry discrete signals and are combined to form white light before being split off again at the other end. The technology is designed so that no particular transport protocols are required, and various types of native network and communications protocols are simply sent over the specific channel, to be utilized natively at the other end. **One beam of light** on a fiber can carry 32 or 64 channels of discrete data at full fiber speed. This technology will increase the fiber capacity by a minimum of 32X and is expected to forestall the desire to lay more cable across the country.

Now it looks as though HP is using some form of WDM in its efforts to develop the next-generation Ethernet, standard **10-gig Ethernet**. This should result in simple gigabit Ethernet becoming a commodity soon. I recently wrote about how cool it would be to boost my **home network** from 100 Mbps to gigabit Ethernet and got a slew of mail saying I was crazy even to care. In fact, as I look at **new generations of devices**, such as the Meridian Data Snap Server and the Cobalt servers, which are specialized hard disk subsystems that connect through Ethernet ports, I wonder if some people are missing the point. It's obvious to me that I/O is more important than ever, as users' reluctance to open up a machine to add cards becomes more prevalent.

As processors begin to achieve gigahertz and faster speeds with faster buses, the computer boxes of the future will become more shielded, possibly to the point that once they're made, **they cannot be legally opened**. Thus high-speed connectivity outside the box becomes more important than ever. USB is finally taking hold, SCSI works as advertised and is much faster, and Ethernet is now tried and true. FireWire is the only wild card, and if it takes hold, that will be just icing on the I/O cake. To most observers there's no doubt that **the computers of the future** will not be things that we open up much, if ever. And we won't have to, with high-speed data channels of all sorts flowing in and out.

Microsoft's Interesting Schemes Dept.: According to internal documents, the **rollout** for Microsoft's next wave of operating systems begins later this year with the release of Windows 98 OSR1. I hope this will be something **downloadable off the Web** for easy updating. As for new features, the company intends to do more than simply incorporate Internet Explorer into the next version of Windows 98. It will more **tightly integrate** all Internet access, letting people go online effortlessly. The idea is to stave off users' jumping

to AOL, which is likely to remain bundled by vendors.

There have been **rumors about an AOL-centric box** floating around, and Microsoft wants to nip any such product in the bud. **Two schemes** are afloat. The most likely is that AOL will market a complete "Internet solution" in the form of a **free computer** with the purchase of two years of AOL advanced service at \$30 to \$40 month. This computer will be essentially a sub-\$400 machine, which should work fine as an AOL and Net-browser box. Since Microsoft is rumored to charge vendors between \$40 and \$75 for a copy of Windows, it's expected that cutting them out of the deal would save millions.

Bundling such a unit with **BeOS, Linux**, or any number of

OSs with a GUI and some simple applications could be very appealing to the next generation of buyers. Especially if it were all free. AOL would bring in from \$720 and \$960 for the two years of service, which should easily pay for the box. And you can assume that users would continue the service for years after that. Newer AOL users seem **more loyal** than the early adopters who passed through on its learning curve. This is what put AOL **on top of Microsoft's enemies list**. People always believed that Netscape had been working on some sort of network OS that might also be part of this plan.

Microsoft is simply going to do everything it has to do to keep such a plot from becoming successful. Unfortunately, the company has had **no success** understanding the appeal of AOL: simplicity. The Neptune OS will address this, as does a new concept called the *Immersive MSN Client*, also referred to as **One-Click MSN**, which incorporates one frame for e-mail, browsing, and ICQ-like buddy lists.

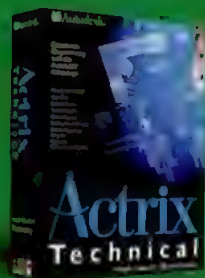
One new tactic Microsoft is employing is the AOL technique of updating users whether they like it or not. People have gotten used to AOL doing this, but whether they will **tolerate Microsoft doing so** is another question. Many users suspect that Microsoft is more concerned with finding bootleg software than improving the user experience. Presumably there's no reason for AOL to spy on a user but plenty of reasons for Microsoft to do it. Microsoft does not seem to understand this dilemma. Expect a **backlash** similar to the Pentium III serial-number scandal.

Genuinely Interesting Reading Dept.: While on the subject of Microsoft: Edwin Black, one-time publisher of a major OS/2 magazine, has published a novel about Y2K. It's about an OS similar to Windows, a **guy similar to Bill Gates**, and a fascinating history lesson wrapped into a compelling story. Check out *>Format C:* from Brookline Books if you're looking for good, **sinister** reading. **PC**

*There have been
rumors about an
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A Tale of Two Gizmos

Well, here I go again. As I said a couple of issues back, I often use computer products in very different ways than their designers intended. What the heck: I'm the customer, and I can do whatever I want with this stuff, huh? I fell in love with Gizmo Number One, the Diamond Rio MP3 "RAM-man" music

player, the first time I got my hands on one, last fall (www.diamondmm.com). And I reveled in Diamond's legal victory over the recording industry, which tried to squash the Rio. As my colleague John C. Dvorak said, the recording business got what it deserved, especially after stomping DAT as a consumer recording medium a decade ago.

I'm a big fan of MP3-formatted music. I keep a lot of MP3 tracks on my notebook, including my own music, and use that notebook as a background-music machine when I'm working long nights away from home in hotel rooms. It keeps me away from CNN and those Movies You Know You Shouldn't Watch on the hotel's pay-per-view system.

The very best thing about the Rio is that I can have a diverse mix of music in the machine: Latin jazz, opera arias, cello solos, Tito to Luciano to Yo-Yo without changing or even carrying disks. (Yes, it's easy to make up your own compilation CDs, with your favorites. But I prefer the spontaneity of just sticking in my Rio whatever feels hot to me *right now* and hitting the road. And I can always refresh the contents from the much longer list of tunes I have on my notebook at that moment.)

Like every other Rio user, I want more memory, and as far as I'm concerned, the company could drop those lower-quality/higher-compression settings, which until recently I never used. But it's a great, remarkably fully realized first implementation of a damned good idea.

I've changed how I use the Rio lately, though, as a result of my experience with Gizmo Number Two—the Audible MobilePlayer, intended as a replacement for audiocassette books. The MobilePlayer, lumpier than the Rio but a conceptual twin, is part of an elegantly conceived system that lets you download to the unit a huge range of books, journals, speeches, performances, radio broadcasts, and TV sound tracks.

I like the MobilePlayer, and I like Audible's civilized pricing even better. For example, the almost-8-hour, unabridged, downloadable Audible recording of Jon Krakauer's sensational *Into Thin Air* costs just

\$10.95. At Amazon.com, you'll pay \$20.97 for the unabridged audio cassette recording of the same book. (Or \$16.39 for the hardback or \$6.39 for the paperback.) Amazon.com adds a few dollars and a few days in shipping costs and time; Audible's version, downloaded more or less instantly, carries no delivery tariff.

The Audible player isn't MP3-based and is in some ways the better for it. For example, the first version could hold 2 hours of material; a new version, just shipping, can hold over 7 hours of audio books—far more than the Rio at any compression-scheme setting.

But the MP3 standard is obviously going to be a Big Thing indeed, and since Audible has established that it's a content player and not wedded to hardware sales, the company's beginning to make some of its material available for free as MP3 downloads for the Rio. You can take a look and grab some samples at www.audible3.com, and you can see the full range of Audible content for sale at www.audible.com.

You'll be jealous. Right now there are more than 6,500 Audible-format items available, but only a handful are in MP3. Audible says more MP3-compressed files are coming soon, but "soon" tends to be a highly variable variable in this business. Don't hold your breath.

If you have a Rio, however, there's no reason not to start sampling around now on the Audible3 page. Even if you listen to MP3 files only on your notebook or desktop PC, take a look. You may well wind up singing along as you work to Rich Little's send-up of Bill Clinton singing "Call Me Irresponsible."

I don't like carrying a pocketful of similar gizmos, so for me the answer is to carry a Rio, with my ever-expanding library of MP3 files on the notebook that I usually bring along. I have some Audible content on the notebook's hard disk too, so now I can flush the music on the Rio, load Audible's audio books, and lose myself in something.

Before long, larger-capacity Rios will knock out Audible's proprietary players. Everything's going MP3, and if you doubt it just talk to a teenager.



I've changed how I use the Rio lately as a result of my experience with the Audible MobilePlayer.

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Jim Seymour

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Update. At the end of 1998, I reported here that I'd found a really extraordinary line of notebook carrying cases, from a tiny Pennsylvania company called CODi. I've put a lot of miles on a \$159 CODi Diplomat AirPro bag since then, and it's as tight and tough as ever. Indeed, despite my abuse, it still looks brand-new.

There are three keys to CODi bags: great design, superb materials and construction, and a very effective shock-proofing system, AirPro, based on a sealed air-pillow sleeve that holds your notebook tightly. CODi says a notebook will survive a drop of 6.5 feet in an AirPro bag. I haven't intentionally dropped my notebook in a CODi case to test that claim, but I have dropped my CODi bag 2 or 3 feet twice, with nary a problem.

CODi recently rolled out two new designs I'd suggested, and both are winners. The new \$159 CODi Mobile Office is a wheeled, roll-on suitcase-style bag, which lets you carry a notebook, perhaps a small printer, and a change of clothes without breaking your back. CODi wisely scaled the case size down a little from that of many roll-on bags, meaning it fits perfectly in the new, more restricted carry-on-bag-measuring devices popping up at airports. And it fits easily into an overhead bin.

At the other extreme, for devoted minimalists, the newest CODi Folio case, at \$59, is the best way I've found to carry a subnotebook, such as the Sharp Actius or Sony VAIO. You can stick in your airline tickets, a magazine, and your car keys—plus all the cords and bits needed to keep the subnote working, including external drives and a power supply—but not much else. If you like to carry the morning papers in your bag, this one isn't for you.

Both the Folio and the Mobile Office use foam padding, not AirPro, but both feel very safe to me.

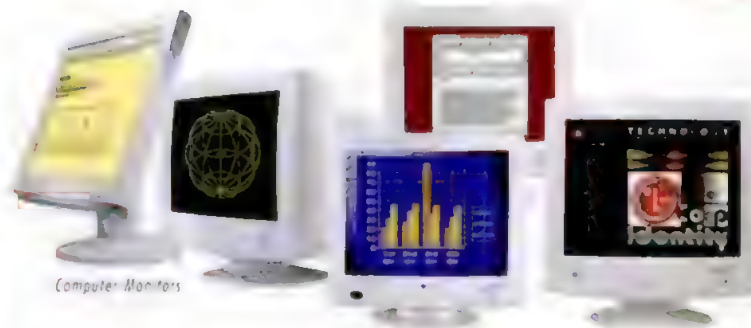
CODi brags that these bags are American-made and show it. The company is convincing me that the phrase means something again.

Sold direct at www.codi-inc.com. And highly recommended. **PC**



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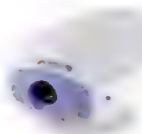
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Get into Gear

Surely you've seen the ads showing smiling notebook PC users at work on beaches, in cars, and on grassy mountainsides. Truth be told, there's not a snowball's chance you could read much of anything on the screen on cloudless days. Unless, that is, you're carrying an odd-looking but useful sun visor

for your notebook. This has proved one of my favorite gadgets of late. Here's a rundown on several gadgets I've found useful.

Laptop shade. If you must work outdoors with a notebook computer (some people assume that anyone using a computer outside can't strike the proper balance between work and relaxation), the ErgoTech PC Laptop Adjustable Visor, from ErgoTech International (\$39.95 direct, 949-252-1612, no Web site), gives you a fighting chance to see what's on the display. The visor provides enough shade to let you work on a sunny day while sitting on a porch, under a tree, or on the sunny side of a plane when your seatmate won't pull down the window shade. On a bright day with no overhead cover, you'll still be overwhelmed by ambient light. The visor is a flat, black, plastic shield that unfolds and shrouds the top and sides of your display. Overlapping sections adjust the visor to fit any display, and hook-and-loop fasteners hold it to your display; it folds up to about half an inch thick.

No-slip mouse pad. When the underside of your mouse collects a load of dirt and oil, it doesn't track well on giveaway foam mouse pads. The 3M Precise Mousing Surface (\$15 street) has been the standard for the past three years; it's ultrathin (you can carry it on the road) but a bit abrasive on your hand. Now comes the new Case Logic GLM-4 ExacTrak mouse pad (\$20 street, 800-447-4848, www.caselogic.com), which provides a similarly precise, nonslip surface. Case Logic's pad integrates a gel-filled wrist rest and a strain relief for your mouse cord that alleviates the annoying tug you feel when your cable snags on a desktop object. It feels a bit softer rubbing against your hand than the 3M pad.

Cable hider. My desktop PC has 20-plus cables connecting all my devices; it looks ugly from the back, and the problem is only getting worse as external devices running USB replace internal peripherals. I've tried flexible plastic tubing or conduits (sometimes called *wiring looms*) to hide up to half a dozen cables. But it's slow work sliding cables in, and I often scrape my hand on the sharp edges of the tubing seam. A more

workable solution is a nylon fabric sleeve called the Wrasse Cable Snake (\$12.95 direct, 408-230-4379, www.wrasse.com/cablesnake). Hook-and-loop fasteners run the length of the sleeve, so it's easy to open and close, and you can break the cable out anywhere along the 3-foot length of the sleeve. Black nylon Cable Snakes are the norm; you can special-order brighter colors and (in quantity) longer lengths.

Road-warrior modem connector. In places where you can't find an RJ-11 jack, where the phone is digital, or where you're not sure whether the phone is digital, you can always connect via the handset. The same connectors are used on phones throughout the world; they're more universal than RJ-11. The Hello Direct LineStein Digital Adapter (\$119.99 direct, 800-444-3556, www.hellodirect.com) is just about the neatest, best-looking handset coupler I've seen, and it's the easiest to adapt to different phone lines and phone characteristics. You press one button and the LineStein trains itself. One drawback is that the LineStein currently requires a transformer that weighs three times as much as the unit; competitor Konexx lets you use internal batteries.

Road-warrior speakers for noncritical listening. The speakers built into your notebook computer are hardly better than having no sound at all. Conversely, desktop speakers that sound good take up too much space in your travel bag. I had high hopes for the Kodel FlatOutTraveler speaker system (\$69 direct, 847-352-6480, www.kodel.com), which uses NXT's flat-panel technology. The good news is that the speakers are small, fold up nearly flat into what looks like a big CD wallet, and do improve the sound coming from your notebook computer. The mixed news is that the FlatOutTraveler is not ruggedly built, and the sound won't dazzle you; frequency response does not extend below 200 Hz. I took the FlatOutTraveler on a few road trips and decided that on the whole, the amount of sound improvement wasn't enough reason to warrant ejecting even one piece of clothing from my suitcase to make room for the 9- by 9- by 3-inch speaker/CD wallet. **PC**



ErgoTech's visor provides enough shade to let you work on a sunny day, while sitting on a porch or on the sunny side of a plane.

More on the Web:
Have you tried any of these gadgets? What do you think? Join our online discussion.

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AT YOUR INTERNET SERVICE



An Internet service provider is more than just an access number.

Today's ISPs offer a full menu of services for individuals and small businesses.

We tested the leading ISPs to determine which ones deliver.

By GREG ALWANG ☛ When you go to a restaurant, you expect good service. But good service is not something most of us have learned to expect from our Internet service providers—despite the moniker. Busy signals and dropped connections are all a part of life in the Internet era. But you don't have to put up with it. Not all ISPs are created equal, and where you choose to spend your \$20 a month will determine how easy it is to install and configure the software, what kind of performance you'll get, and the content and services you can choose from.

According to some estimates, as many as 17 million people will get on the Internet for the first time this year. Competition for new and existing Internet users has become intense. The largest ISPs and

online services have been bulking up in anticipation of a shakeout. America Online, which acquired CompuServe, claims to have 16 million members, which makes it larger than all the other ISPs in our story combined. Sprint is now a part of EarthLink, and MindSpring recently acquired Netcom. MCI, which shed its consumer dial-up business when it merged with Worldcom, just announced that it will be re-entering the fray.

To complicate matters even more, today's ISPs are more like yesterday's online services, and vice versa. AOL and CompuServe 2000 use embedded versions of Microsoft Internet Explorer 4.0. MSN Internet Access and Prodigy Internet are now ISPs, rather than online services. At the same time, most major ISPs have taken

Our Contributors: GREG ALWANG, JAN OZER, and M. DAVID STONE are contributing editors of *PC Magazine*. ROBERT LIPSCHUTZ is a frequent contributor. MAGGIE OVERFELT is an editorial researcher at *PC Magazine*. DIANE JECKER was the project leader, and JOHN MORRIS was the associate editor in charge of this story.

Menu

PRIX FIXE: \$20 A MONTH

All the Internet service providers (ISPs) reviewed here charge approximately the same amount of money for unlimited access. While performance is a major differentiating factor, we were surprised to find that there are also big differences in the features these services offer.

✧ SETUP AND SOFTWARE ✧

The hardest part of using the Internet is getting online in the first place. For starters, you must install and configure the software, and select the appropriate access numbers. Fortunately, most major ISPs have found ways to ease the process. • Among the best are America Online, CompuServe 2000 (which uses the same setup as AOL), and EarthLink Sprint.

✧ E-MAIL ✧

Most ISPs offer each customer one or more standard POP3 e-mail accounts and a full-featured e-mail client. AT&T WorldNet supports six e-mail accounts, while AOL and CompuServe 2000 offer five each. AOL and CompuServe 2000 use proprietary e-mail systems that are more limited than POP3 e-mail clients. MSN Internet Access also uses a proprietary system, but because it uses Outlook Express, the e-mail client included with IE, it offers the same rich features as true POP3 e-mail systems. AOL's NetMail, AT&T's Message Center, and MSN's Hotmail also let you check e-mail from a browser. • We really liked it when a service could quickly notify users of new e-mail messages. EarthLink, MindSpring, MSN, and Prodigy Internet all offer this feature from the start page or desktop.

✧ CONTENT ✧

How much significance you attach to Web content will depend on your level of experience. Novices will appreciate the way online services such as AOL and CompuServe package and organize content so it is easy to find, while more advanced users will prefer the unfiltered Web experience. • Regardless of your experience, it is nice to have a broad selection of content at your fingertips. Many ISPs have formed partnerships with Web portals such as Excite, Planet-Direct, Snap, and Yahoo! to provide these services. • Most of these services are available to anyone on the Web, but ISPs can make them easier to access and personalize.

✧ PERSONAL WEB PAGES ✧

All the ISPs we looked at except MSN provide space on their servers to host your own Web pages, as well as tools for creating them. Prodigy provides a set of templates that you customize, whereas AT&T, Concentric Network, and EarthLink offer online, wizard-style Web page builders. But these are all somewhat limited. A few ISPs bundle full-fledged WYSIWYG editors. • The amount of server space also varies. AOL and AT&T WorldNet offer as much as 2MB per user and 5MB per user, respectively. EarthLink offers 6MB, while Concentric lets you supplement its 5MB by adding space in increments of 1MB at \$1 per month.

✧ SMALL-BUSINESS SERVICES ✧

All of these ISPs offer dial-up access at speeds of up to 56 Kbps (V.90). Some also provide faster access at an additional cost. Fast-access options can include ISDN, ADSL or *asymmetric digital subscriber line service*, and cable modems (see "Faster Web" in this issue for more details). • Many small businesses will need more server space and e-mail addresses than a personal account affords. Concentric's Web hosting ranges from \$24.95 per month (for 30MB of server space and five e-mail accounts). A handful of ISPs provide VPN (virtual private networking) services. Concentric's VPN options include point-to-point WAN connections and tunneled dial-up access for remote users.

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PC EDITORS' HOT LINKS

www.pcmag.com/hotlinks

► Internet User

www.zdnet.com/products/internetuser
ZDNet's InternetUser site is packed with information on ISPs, including the ISP Survival Guide and ISP Info for Road Warriors.

► The List

<http://thelist.internet.com>

The self-proclaimed definitive ISP buyers' guide, The List includes a database of over 8,500 ISPs, searchable by area code. It also has links to other useful resources.

► ISPcheck

www.ispcheck.com

More than just a searchable list of ISPs and hosting services, ISPcheck includes an Internet Services Glossary and a checklist that will help you select the right dial-up Internet access provider.

► Online Connection

www.barkercs.org/online/index.html

This site is a compilation of reviews, news, profiles, and resources regarding some of the larger ISPs.

► ISP Finder

<http://ispfinder.com>

Besides yet another database of ISPs listed by area code, this site includes a list of Internet terminology and ten questions you should ask your ISP.

some cues from the online services. EarthLink's setup rivals AOL and MSN in simplicity, and all major ISPs have enhanced their content by developing their own start pages or partnering with existing Web portals such as Excite and Yahoo!

These changes make choosing an ISP or online service like tracking a moving target. But there are important distinctions.

The first is performance. Although all eight ISPs we tested offer V.90 dial-up access, not all deliver the same performance. For this story, we used data supplied by Inverse Network Technology to measure key factors such as the odds of getting through to your ISP at different times of day, how long it takes to log on, and the time it takes to download a typical Web page.

The services you get also vary greatly. Most of these ISPs include only one e-mail account, while AOL and CompuServe 2000 offer five, and AT&T World-

Net gives you a half-dozen AOL, CompuServe 2000, and MSN use proprietary e-mail systems; the rest offer standard POP3 accounts. Except for MSN, all of these services let you carve out your own home on the Web, but the authoring tools you get and the amount of space you have to work with vary.

Even the smallest of businesses will quickly outgrow these constraints, but most ISPs provide additional services at extra cost. For faster access, many providers are rolling out technologies such as ISDN, DSL (digital subscriber line), cable, and leased lines (T1, T3, and so on). Generally, these services are still only available in selected areas (see "Faster Web" in this issue for more details). Other advanced services include Web hosting packages, e-commerce support, and virtual private networking (VPN).

There's a lot to think about before selecting an ISP. In the pages that follow, you'll find everything you need to make the right call.

All reviews by Greg Alwang

America Online 4.0

\$21.95 per month for unlimited usage. America Online Inc., Dulles, VA; 800-827-6364, 703-265-2120; www.aol.com.

● With 16 million members, America Online is clearly doing something right. To start, AOL offers a proprietary client based on Microsoft Internet Explorer 4.0, enhanced features, and more content than a New York City newsstand. But the real key to AOL's popularity is that it offers the easiest on-ramp to the Internet.

Enhancements in Version 4.0 include a streamlined setup, a richer e-mail client, and the ability to switch between up to five screen names without disconnecting. Like MSN Internet Access, AOL detects and works with existing TCP/IP and LAN connections.

AOL has mastered the concept of "packaging" content. Be it personalized news, online chats, or shopping, AOL has something for everyone. The popular channel metaphor is still present, and you can enter either AOL keywords or URLs to jump directly to proprietary con-

tent or browse Web sites. Furthermore, the AOL.com site lets you access some of AOL's content from a standard browser. If you use another service for Internet access, you can get access to all of AOL's rich content for \$9.95 a month—a great option for those who use a cable modem or DSL.

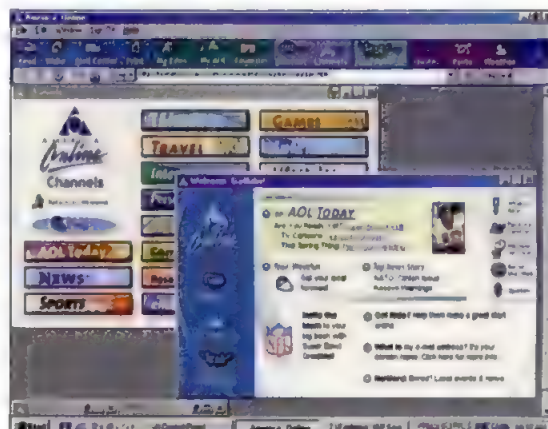
The largest service by far, AOL is a victim of its own success, suffering high call failure rates during evening hours. On the other hand, AOL sets the standard for download times and throughput, thanks to its advanced caching and compression technologies. So if you have the luck to get a good access number, you may find that performance is fine.

The AOL e-mail client now has spell-check and auto-compression features, but it still sends e-mail with attachments in the foreground and doesn't fully support HTML mail. The new NetMail service—AOL's answer to MSN's Hotmail—lets you read and compose e-mail using a standard browser. And the Instant Messenger lets you communicate in real-time with other Internet users.

For Web pages, AOL provides 2MB of space per screen name. You can create Web pages using the online Personal Publisher or the free AOL Press tool.

Starting this summer, AOL plans to offer DSL service in the Northeast for about \$20 extra per month. AOL's Prime-Host subsidiary offers business Web hosting options starting at \$99 per month for 50MB.

More experienced users may opt for the open road of a traditional ISP such as AT&T WorldNet, but America Online 4.0 is a good choice for beginners and many mainstream users.



America Online is the king of content. Channels lead to the most popular areas.

AT&T WorldNet

\$21.95 per month for unlimited usage. AT&T WorldNet, Basking Ridge, NJ; 800-967-5363; www.att.net.



With an infrastructure that comprises part of the Internet backbone, AT&T WorldNet Service is not surprisingly a peak performer. AT&T WorldNet is also an excellent value with support for multiple users, lots of server space for personal pages, and a range of big-business services. Though it neither offers the smooth setup of AOL or EarthLink nor matches their Web content, AT&T WorldNet is still the best choice for mainstream and experienced Internet users.

Like AOL, AT&T WorldNet has edged above the \$19.95 all-you-can-browse plan to \$21.95 per month. But you get a lot of services—not to mention unparalleled performance—for that extra \$2 per month. For instance, you get support for up to six users and 30MB of Web server space (5MB per user). In addition, you get instant messaging software and a free, one-year subscription to a parental content-filtering program.

During installation, AT&T WorldNet copies a help database and a handy Fix It utility to your local disk to help diagnose and resolve common configuration problems. Fix It can also restore personal configuration settings and reinstall missing software components.

Although AT&T WorldNet plans to expand its content through partnerships with Excite, iVillage, Yahoo!, and others, at present it can't match AOL, CompuServe, or MSN Internet Access in this area. But it does offer some welcome ease-of-use features. The AT&T WorldNet home page has a convenient navigation bar along with a list of content categories. A floating toolbar stays with you as you venture around the Web.

More important, AT&T WorldNet consistently outperformed the other seven ISPs we tested; it had the lowest call failure rates at all times of day and download times second only to AOL's. Only Prodigy Internet came close to delivering this level of performance.

AT&T WorldNet offers two choices for creating personal Web pages, a Java-based personal Web page wizard or a set



of templates. Like AOL's Personal Publisher, these tools are designed for building only the most basic pages. AT&T also offers business Web hosting, e-commerce, business-to-business transactions (EDI over IP), and a range of VPN options.

Although AT&T WorldNet is a little behind the pack when it comes to setup and content, its reliability, top-notch performance, and value make it the best choice for consumer dial-up Internet access.

AT&T WorldNet performed well across the board on our performance tests, which were based on data from Inverse Network Technology. Most notable were its call failure rates, which were significantly better than the industry average, regardless of the time of day we called. In addition, AT&T WorldNet's Web page download times were second only to America Online's.

of templates. Like AOL's Personal Publisher, these tools are designed for building only the most basic pages. AT&T also offers business Web hosting, e-commerce, business-to-business transactions (EDI over IP), and a range of VPN options.

CompuServe 2000

\$19.95 per month for unlimited usage. CompuServe, Columbus, OH; 800-848-8990, 614-457-8600; www.compuserve.com.

● Known for providing world-class content and thriving online forums, CompuServe—now owned by America Online—enters its twentieth year having put a new face on a tried-and-true service. CompuServe 2000 caters to busy adults and business professionals by skipping the fluff in favor of business-centric channels and forums.

At sign-up, you choose between CompuServe 4.0 (\$24.95 per month) and the new CompuServe 2000, which supports only Windows 95 and 98. Both offer

EDITORS' CHOICE

• AT&T WorldNet

It doesn't matter how much great content your ISP provides if you can't get connected and get to that content efficiently. That's why performance is so

important in this category. In terms of performance, no other major,

national ISP can match AT&T WorldNet, which is why we've chosen to give it our Editors' Choice for consumer dial-up service.

But there's more to AT&T WorldNet than performance. For \$21.95 per month, you get unlimited Internet access, support for up to six users, 5MB of space per user for personal Web pages, and an instant messaging client. AT&T WorldNet is also working to broaden its content through deals with Excite, Yahoo!, and others. For businesses, AT&T offers Web hosting and e-commerce services, plus VPN plans at an extra cost.

When you add this long list of features to its top-notch performance, you can see why AT&T WorldNet is currently the one to beat in this highly competitive market.

the same content, but CompuServe 2000 more closely resembles AOL, with an identical installation routine, the same e-mail client, and a similar interface. It also shares the same V.90 network as AOL, so the performance you get will depend on the version you choose.

CompuServe 2000's intuitive toolbar and new main menu page let you set up your personal news topics, access market reports, and jump right into the information channels. Meanwhile, a scrolling ticker offers up-to-the-minute news headlines that link to full stories. You can search for information by topic or configure iQuest to search major news sources. There's also an excellent shopping section and dozens of special interest forums.

The fully integrated version of Microsoft Internet Explorer 4.0 lets you switch between the Web and proprietary content seamlessly. The enhanced e-mail client supports five e-mail accounts and includes a spell-checker and automatic attachment compression. CompuServe also includes an instant messaging client and its own version of AOL's Buddy List.

CompuServe's Our World section pro-



Powered by



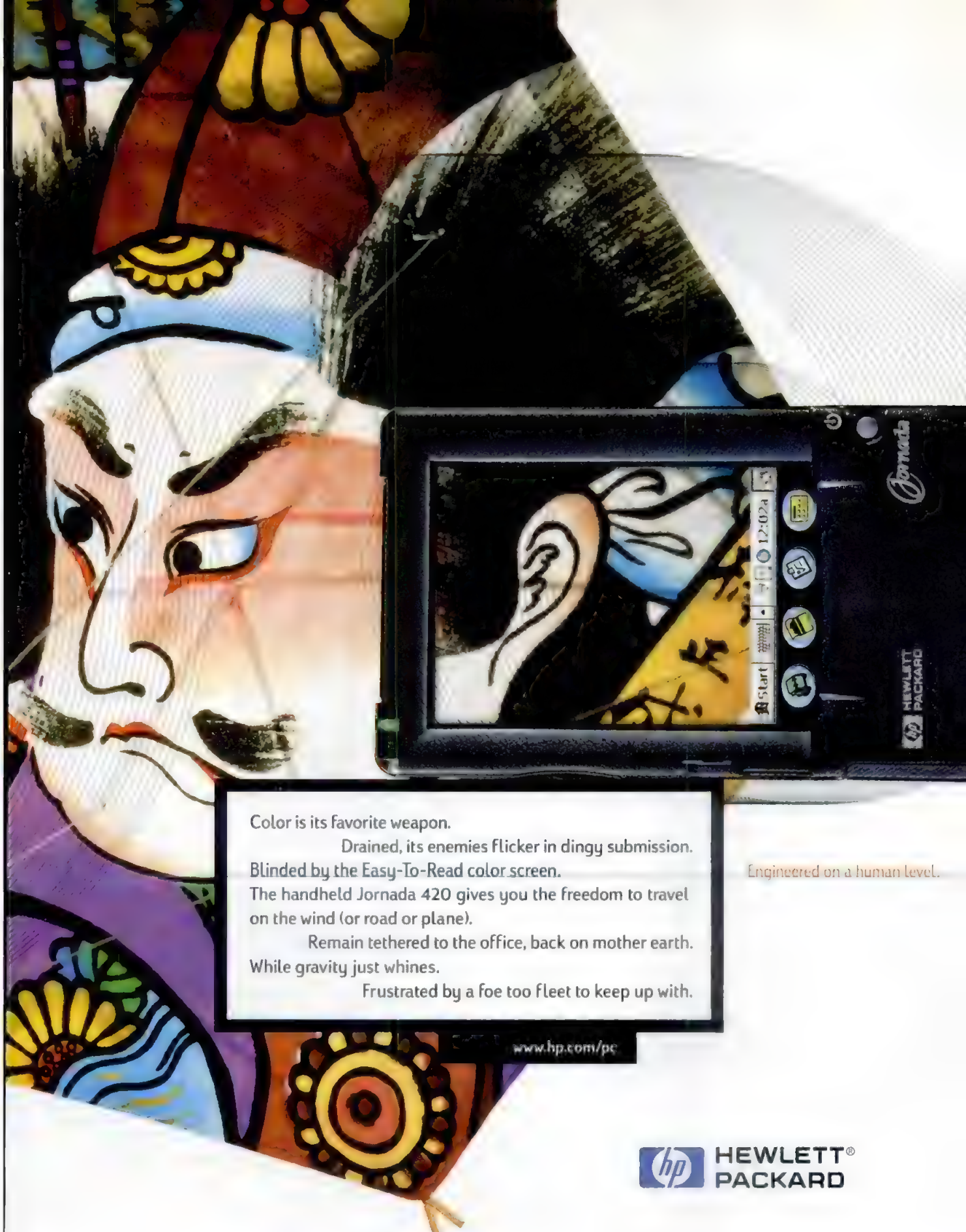
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The PC Magazine Labs Scorecard ratings, based on the reviewers' experiences with the services, are divided into six categories. The **installation and setup** rating is straightforward: Here we look at the user's initial experience with the software installation, the process of signing up for service, and configuration of the software. A key feature in this category is the ability to set up multiple access numbers easily. In **e-mail and newsgroups**, we evaluate the configuration of e-mail clients and news readers, support for multiple mailboxes, e-mail features, and extras such as spam filters. In the **Web content** category, we look for breadth and depth of content

provided either directly by the ISP or through a partnership with Web portals such as Excite or Yahoo! Users should be able to customize the content, layout, and appearance of these pages. All but one of the ISPs we tested (MSN Internet Access) provide server space so you can publish **personal Web pages**. We evaluate not only the hosting packages (which usually provide 5MB to 6MB of space per user), but also the bundled authoring tools. The **small-business services** rating represents a range of higher-end services including fast-access options (ISDN, cable, DSL, or leased lines), hosting packages, e-commerce services, and VPN plans. The final category, **customer service**, covers cost, availability, and quality of support via telephone, e-mail, and the Web.

	Price per month (unlimited access)	Installation and setup	E-mail and newsgroups	Web content	Personal Web pages	Small-business services	Customer service
America Online 4.0	\$21.95	Excellent	Good	Excellent	Good	Fair	Good
EDITOR'S CHOICE AT&T WorldNet	\$21.95	Good	Excellent	Fair	Excellent	Excellent	Good
CompuServe 2000	\$19.95	Excellent	Good	Excellent	Good	Fair	Good
Concentric Network	\$19.95	Fair	Good	Good	Good	Excellent	Good
EarthLink Sprint	\$19.95	Excellent	Good	Good	Good	Good	Good
MindSpring	\$19.95	Good	Good	Good	Good	Good	Excellent
MSN Internet Access 2.0	\$19.95	Good	Good	Excellent	N/A	N/A	Good
Prodigy Internet	\$19.95	Good	Good	Good	Good	Fair	Good

N/A—Not applicable. The vendor does not provide this service.

vides resources for designing, authoring, and posting personal Web pages. (At press time, CompuServe had not determined how much server space the plan will include.) The Personal Publisher is an online wizard similar to AOL's Personal Publisher. For \$79 a month (plus a \$50 setup fee), the small-business package includes 30MB of server space and a copy of NetObjects Fusion. CompuServe also offers corporate dial-up plans with multiple accounts.

CompuServe 2000 was not widely deployed at the time of our testing, however, so the performance tests reported in this story are based on CompuServe 4.0. Because CompuServe 2000 uses the same network as AOL, the call-failure rates for the newer service will be similar to those reported for AOL, so expect to have more trouble getting through at night.

CompuServe's new look is appealing, and the service still offers the best user forums. For now, CompuServe has gotten a new lease on life under AOL's stewardship.

Concentric Network

\$19.95 per month for unlimited usage. Concentric Network Corp., San Jose, CA; 800-373-3676, 408-817-2800; www.concentric.net.

● A full service ISP, Concentric Network boasts the broadest range of options of the major ISPs we reviewed. Although it

specializes in business services such as Web site hosting, dedicated access, and VPNs, Concentric also offers dial-up consumer access, the focus of our testing.

The starter kit includes both Microsoft Internet Explorer and Netscape Communicator. Installation is a snap if you plan to install one or both of the provided browsers. But if you don't want to overwrite an installed browser, you'll have to call customer support or access Concentric's site to obtain DNS, IP, and mail server settings, so installation gets a little trickier. The default Concentric home page links directly to Excite, PlanetDirect, and Snap—all of which can be personalized.

To create your own Web page, Concentric includes 5MB of server space and the online Starter Page option, which lets you create a very basic page by answering a series of questions. Concentric's site is packed with tips on designing simple to advanced Web pages.

Concentric is a highly flexible service. For instance, you can add POP3 e-mail accounts for \$2 each per month or augment the 5MB of server space for \$1 per megabyte per month. In addition, Concentric is currently roll-

ing out DSL service in 6 major metropolitan areas, with 20 more to follow this year.

On our performance tests, Concentric generally delivered average performance numbers. But during business hours, its call failure rate was worse than the industry average of 7.0 percent—a trend we saw in other business-oriented ISPs such as CompuServe 4.0.

For businesses, the ConcentricHost packages range from \$24.95 per month for five e-mail accounts and 30MB of server space to \$375.95 per month for 100 e-mail accounts, 300MB of space, and SSL (Secure Sockets Layer) support for secure online transactions. Concentric's Virtual



Concentric has partnered with several portals. PlanetDirect is shown here.

Internet Service Providers



In a recent J.D. Power and Associates survey, users said online access was the most important factor in determining overall satisfaction with an ISP. Getting connected is what it's all about. Currently, no major ISP is doing this better than AT&T WorldNet.

Our ISP performance results are based on data supplied by Inverse Network Technology (www.inversenet.com), one of the leading providers of ISP performance measurements. The tests can be divided into two general categories measuring the likelihood of getting a connection at different times of the day (call failure rate) and the performance you'll get once connected (log-on time, download time, and Web throughput). In concordance with our agreement with Inverse Network Technology, all scores worse than the industry average are reported simply as *worse than average*. Keep in mind that the difference between a numerical score and a score of *worse than average* could be as little as one-tenth of 1 percent.

AT&T WorldNet had the lowest call failure rates across the board. Over a 24-hour period and during business hours, AT&T WorldNet's call failure rate was a remarkable 2.0 percent, compared with an industry average of 6.9 percent. During the evening, its call failure rate was higher (4.7 percent) but still significantly better than the industry average (13.6 percent) for that time of day. In fact, AT&T WorldNet was one of only two ISPs that beat the industry average in all three categories. The other was Prodigy Internet.

At the opposite extreme were EarthLink Sprint and MSN Internet Access, which failed to meet the industry average call failure rates in any of these categories. The other consumer-oriented ISP, America Online (AOL), also had trouble during peak evening hours and over a 24-hour period. By contrast, ISPs with more business users such as CompuServe, Concentric Network, and MindSpring tended to perform better during evenings than during business hours. The differences between day and evening call failure rates are a factor to keep in mind both when choosing and when using an ISP.

CompuServe actually offers two services: CompuServe 4.0 (or Classic), which uses its own network, and CompuServe 2000, which uses the same network as AOL. The performance test scores reported here are based on CompuServe 4.0; if you use CompuServe 2000, the call failure rate will be similar to that of AOL. In other words, you'll be competing with 16 million AOL members for access during busy evening hours.

Once you get connected, you can expect to wait about 30 seconds to log on to the service. MindSpring and AT&T WorldNet delivered the fastest log-on times, but only about 5 seconds separated these from the industry average, so log-on time is not a major factor. The download time and throughput score, however, are indicative of the performance you'll get when using an ISP.

To come up with the Average Download Time, Inverse Network

Technology measures the time from when a page is requested to when it is completely downloaded using 20 popular Web sites. In this category, AOL has a decisive lead, delivering a page to your desktop in 15 percent less time than the average ISP and in 7 percent less time than the next-fastest service, MindSpring. Besides its large cache system and private Internet access points, AOL achieves this by using an image-compression technology that shrinks Web pages. Five of our eight ISPs were above average on the download times (AOL, AT&T WorldNet, Concentric, MindSpring, and Prodigy Internet). These same ISPs were at or above average on the Average Web Throughput test, a related test that measures the rate at which data is downloaded in kilobytes per second (KBps).

To calculate performance, Inverse Network Technology's Internet Measurement Service made 181,365 access calls to 30 U.S. ISPs between January 6 and January 20, 1999. At least 4,011 calls were made to each ISP. The industry averages are based on results of 13 major providers (AOL, AT&T, Cable & Wireless, CompuServe, Concentric, EarthLink, GTE, IBM, Microsoft Network, MindSpring, Netcom, Prodigy, and UUnet). Testing was conducted using 42 POPs (points of presence) for each ISP, which were selected based on 1990 U.S. Census rankings of standard metropolitan areas with populations of 200,000 or more. The test system was a 266-MHz Pentium II PC with 64MB of RAM and a 3Com Sportster V.34+ internal modem.—Analysis written by Diane Jecker

- Average or better
- Worse than average
- PC denotes Editors' Choice

Bold type denotes first place

We do not report numerical scores for services that performed worse than the industry average

CALL FAILURE RATE

Low scores are best	24 hours	Evenings	Business hours
America Online 4.0	—	—	4.5%
AT&T WorldNet	2.0%	4.7%	2.0%
CompuServe 4.0	—	6.5%	—
Concentric Network	6.4%	10.7%	—
EarthLink Sprint	—	—	—
MindSpring	6.7%	8.3%	—
MSN Internet Access 2.0	—	—	—
Prodigy Internet	3.6%	5.3%	4.7%
Industry average	6.9%	13.6%	7.0%

Evenings: 6:00-midnight local time Business hours: 9:00-5:00 local time

SPEED TESTS

High scores are best	Average Log-On Time Seconds	Average Download Time Seconds	Average Web Throughput KBps
Low scores are best			
America Online 4.0	—	26.3	2.9
AT&T WorldNet	25.4	30.0	2.9
CompuServe 4.0	27.6	—	—
Concentric Network	—	30.5	2.9
EarthLink Sprint	—	—	—
MindSpring	24.6	28.4	3.0
MSN Internet Access 2.6	28.3	—	—
Prodigy Internet	—	30.2	3.1
Industry average	29.6	30.9	2.9

▲ You can count on calls going through with AT&T WorldNet and Prodigy Internet, the only services with call failure rates better than the industry average on all three tests. EarthLink Sprint and MSN Internet Access 2.6 were at

the opposite extreme. Generally, we saw similar results on the Average Download Time and Average Web Throughput tests. Here, however, American Online 4.0, Concentric Network, and MindSpring also performed well.

NetServer E60

SureStore T20

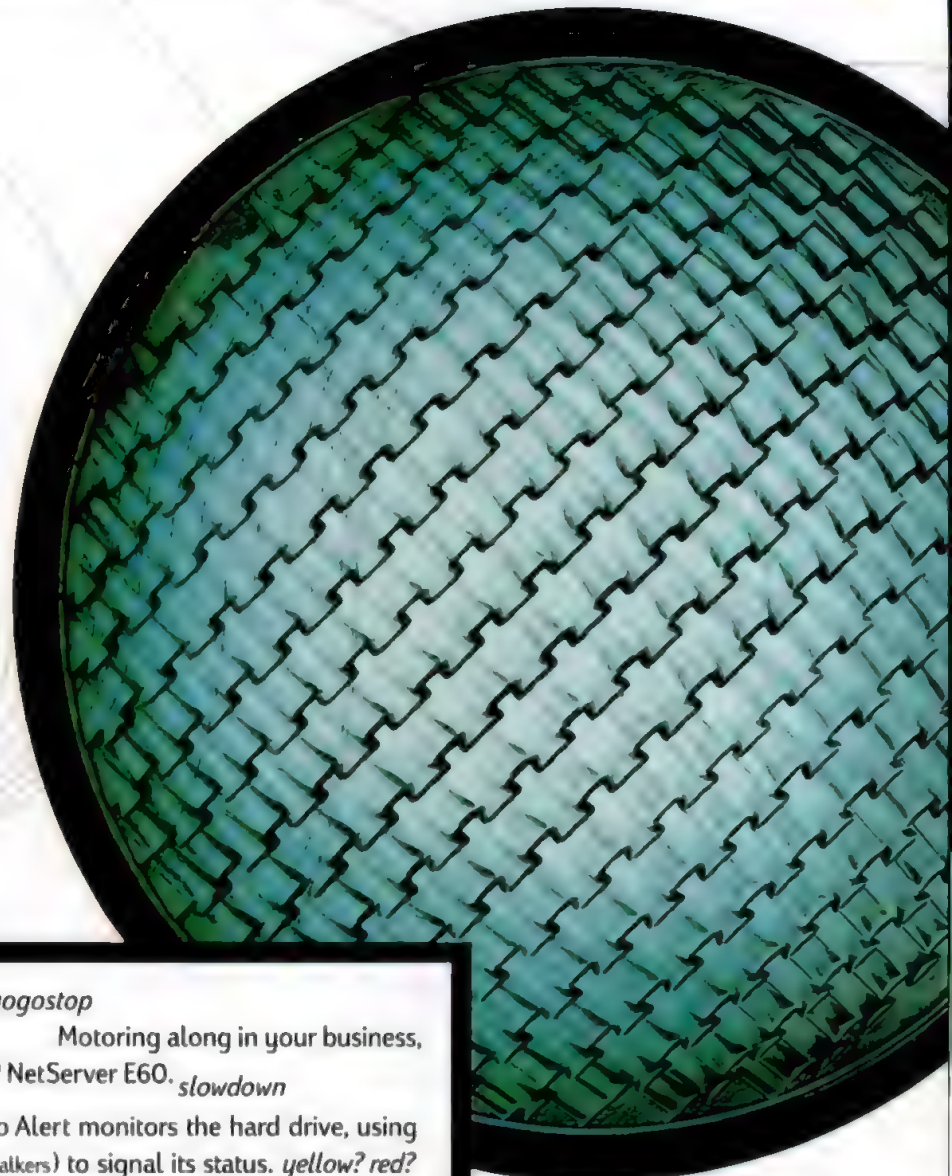
Up to two Intel® Pentium® II processors 400 MHz or 450 MHz, or up to two Intel Pentium III processors 500 MHz with 512 KB cache / 64 MB 100 MHz unbuffered ECC SDRAM standard, expandable to 1 GB / Up to 72.8 (4 x 16.2 GB) maximum internal storage / Integrated dual-channel Ultra/Wide SCSI controller / Integrated 10/100TX LAN Adapter (NIC) / Supports: Novell NetWare® and NetWare for Small Business®, Microsoft® Windows NT® Server, Microsoft BackOffice® Small Business Server (SBS), and SCO® OpenServer™

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pentium III



gogogogogogogogogogostop

Motoring along in your business,
you drive up to the HP NetServer E60. *slowdown*

Auto Alert monitors the hard drive, using
traffic lights (those fast talkers) to signal its status. *yellow? red?*
A quick look informs you what to do to keep things running
smooth. Green light. Nothing to worry about. *gogogogogogo*

Continue through the intersection of Friendly and Easy.
Give the crossing guard of your peace of mind a nod hello.
go

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LOOK, MA! No PC

SURFING THE INTERNET is not just another thing to do on your PC; it has become an end unto itself. One option for users with little computer experience and no need for applications such as spreadsheets is Microsoft WebTV, which brings the Web to your television.

WebTV is available in two flavors. **WebTV Classic** (\$19.95 per month) offers no-frills Web browsing and e-mail. For \$24.95 per month, **WebTV Plus** adds unique features that integrate the Internet and television programming. Each includes six e-mail accounts. If you prefer to use an alternative ISP, you can receive WebTV for \$9.95 or WebTV Plus for \$14.95 per month.

WebTV requires an Internet terminal, either Classic (\$100 street) or Plus (\$200). Either can sit on top of your television, but there are significant differences between the two. Specifically, the Plus terminal includes a faster processor, 8MB of SDRAM, a cable-ready stereo tuner, a 1.1GB hard disk, a 3-D graphics engine, and a 56K modem. Each includes a remote control, but if you plan to use WebTV for e-mail, you'll also want the wireless keyboard (\$50 street). We tested a WebTV Plus terminal



provided by WebTV Networks.

WebTV Networks claims that you'll be browsing the Web within 10 minutes, but our setup wasn't quite that smooth. Illustrated directions for several different

scenarios and all the cables and adapters most users will need (composite and S-Video) were included. Nevertheless, the process took us a couple of tries. And once it was working, the unit required a 30-minute download to update the software.

WebTV's home page includes TV listings, links to essential sites, e-mail, a local city guide, and chat areas. WebTV Plus adds TV listings, WebPIP (which lets you browse the Web and watch television simultaneously), Interactive Television Links, and the ability to pause WebTV when you receive an incoming call.

We were impressed by WebTV's ability to make Web pages look decent on a low-resolution TV. The WebTV browser currently supports HTML 3.2, SSL (Secure Sockets Layer) for secure transactions, and most Web graphics and multimedia formats, including RealAudio and ShockWave. (Microsoft Corp., Redmond, WA; 800-469-3288; www.webtv.com.)—*John Morris*

Domain Environment (VDE) provides a domain name with its own virtual server and operating system, offering increased stability and protection against other domains on the same server. Concentric also offers VPN solutions for companies that require a wide area network.

Concentric can't match the dial-up performance of AT&T WorldNet or Prodigy Internet, nor does the service offer the content of AOL, so most individual users will be better off with one of these more consumer-oriented services. But Concentric's flexible service plans and business services will appeal to small and medium-size businesses.

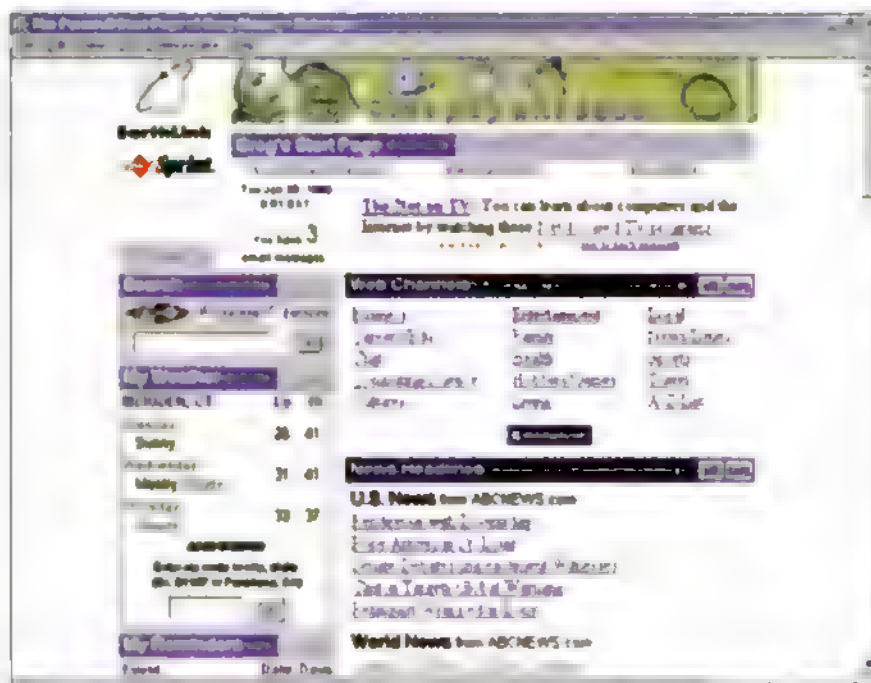
EarthLink Sprint

\$19.95 per month for unlimited usage, plus a \$25 setup fee (waived if you sign up online). EarthLink, Pasadena, CA; 800-395-8425; www.earthlink.net.

● Last year's Editors' Choice EarthLink Sprint still has a lot going for it. Its setup is

easy, it offers a great mix of content, and it has a range of services for individuals and small businesses. Unfortunately, EarthLink seems to be suffering some growing pains—its network performance was consistently worse than the industry average.

The setup program includes a step-by-



Earthlink Sprint's start page is highly customizable, including Web Channels and local weather reports.

step video that guides you through installing and configuring either Microsoft Internet Explorer or Netscape Navigator. A follow-up tutorial provides an overview of using EarthLink's dockable toolbar, browsing the Web, and using e-mail. EarthLink also includes printed guides for new Internet users and AOL converts.

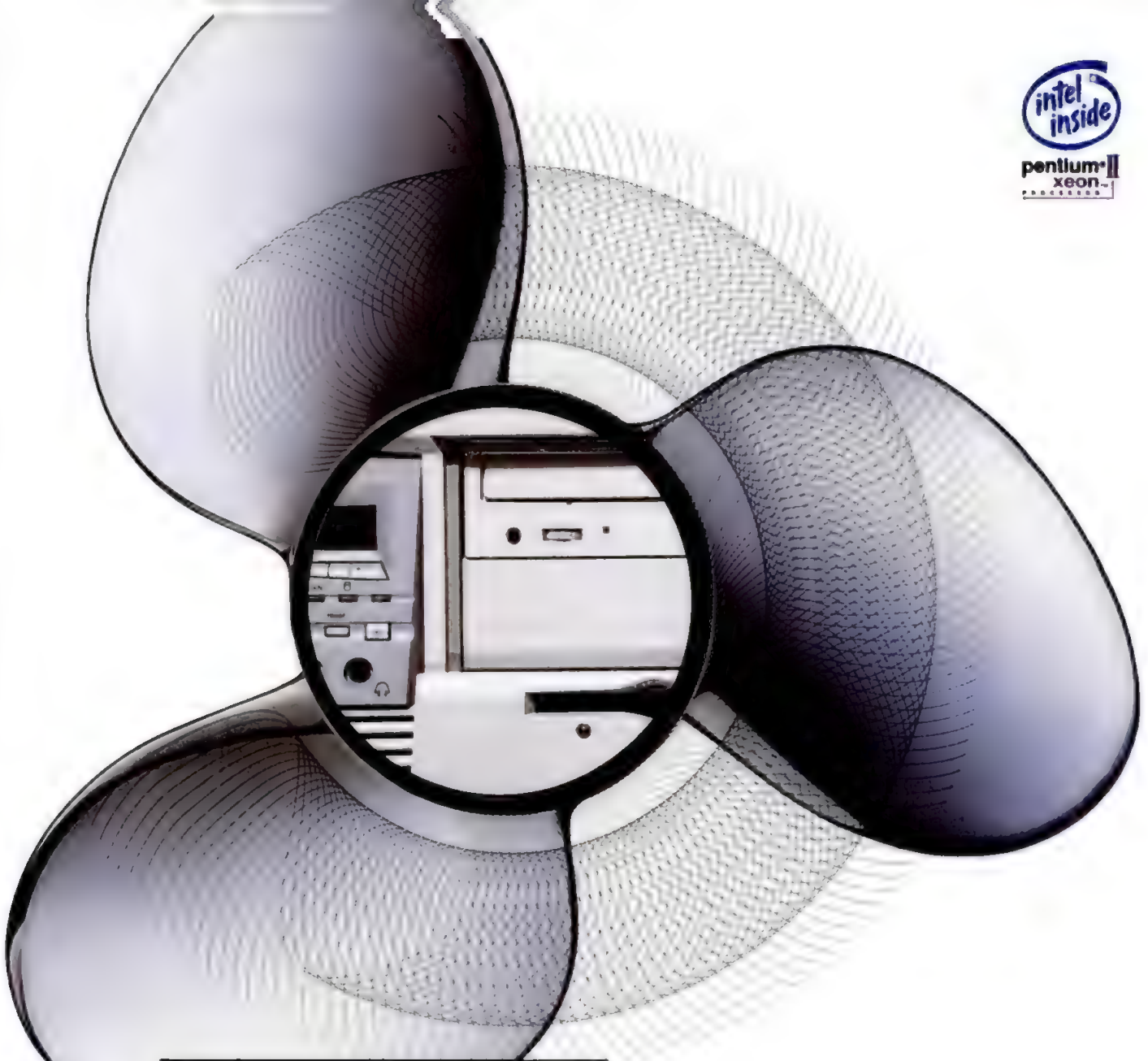
EarthLink's dialer accepts several access numbers and tries different numbers when it encounters busy signals. And that is fortunate since EarthLink, like AOL and MSN Internet Access, scored poorly on the evening call failure rate test. EarthLink users also have a tougher time getting through during business hours, and the service was worse than average in download time and throughput.

EarthLink fares much better when it comes to navigation and presentation of content. The personal start page provides many customization options including content, page layout, and colors. Web channel buttons link to content from well-known sources such as MiningCo.com, PC Quote, and AccuWeather. And features such as Travel Agent and EarthLink Mall offer easy access to popular destinations.

Subscribers get one e-mail account and 6MB of server space for personal Web pages. Click-N-Build, an online Web page tool, takes you through the process of building and publishing basic Web pages. EarthLink bundles Claris Home Page Lite for building more sophisticated pages. And for \$29.95 per year, EarthLink offers Internet Rooms, private chat areas, Internet telephony, and file-storage features.

Web hosting packages start at \$19.95 per month and include a store-building wizard that creates online stores, complete with shopping carts and credit card processing. Individual and LAN-based ISDN, as well as a host of dedicated connections are also available.

The reason EarthLink, with its smooth setup and comprehensive content, has become so popular is easy to see. We recommend, however, that until EarthLink addresses its performance woes, you look to other ISPs such as AT&T WorldNet or MindSpring.



Water displaced creates forward thrust.
Movement. The beginning of voyage.
And what happens when you displace limitation?
When *no, won't happen*
and *can't do that* are left
bobbing in your wake? Where would you journey?
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*Price is estimated street price. Actual price may vary. Monitor not included. Intel, the Intel Inside Logo and Pentium are registered trademarks and Pentium II Xeon is a trademark of Intel Corporation.

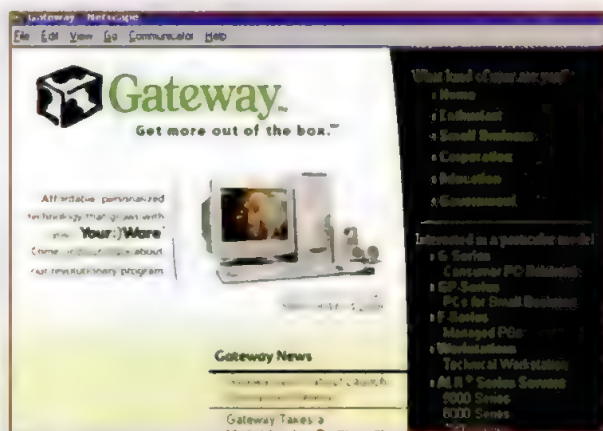
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THE INTERNET IN A BOX

ONE OF THE LEADING REASONS for buying a new PC is to get online. To simplify the process, some PC vendors are now offering branded Internet service right out of the box. Gateway and Micron offer dial-up Internet access, while such vendors as Dell and IBM have partnered with Web portals to offer customized start pages.

When you first boot up your new Gateway PC, one of the first dialog boxes you'll see is an offer for the Gateway.net service (\$16.95 per month for unlimited access). The service, provided by UUnet, consists entirely of 56K POPs (points of presence). All Gateway systems come with Microsoft Internet Explorer and Netscape Communicator, so there's no need to install or configure software. Gateway.net users get a customized version of the Yahoo! start page that includes links to Gateway technical support, product information, and an Internet tutorial.

Micron also offers dial-up services through its Micron Internet Services division, but the service is available only in Idaho, Oregon, Utah, and Washington. Service plans start with Net.Now! (\$19.95 per month—for 150 hours' usage—plus a \$10 setup fee). Like PCs from Gateway, Micron systems come preloaded with IE and Communicator. Members of Micron Internet Services also get a customized version of the Excite home page and a Subscriber's Toolbox, which provides technical-support contacts and account information.



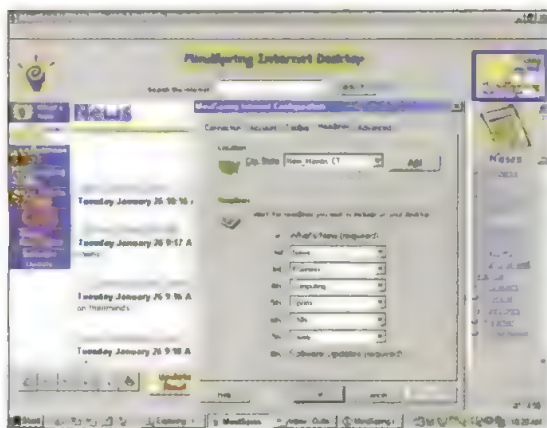
Gateway customers get their own home on the Web with the Gateway.net dialup service.

Through its ConnectDirect program, Dell claims that customers can get online in less than 5 minutes. Out of the box, new Dell computers include preinstalled and preconfigured software for America Online, AT&T WorldNet, GTE, SBC, and U S West. Furthermore, through a partnership with Excite, Dell provides each customer with a customized Excite home page. In addition to all the usual content you'd expect from a leading portal, the pages include links for Dell customer support. IBM has formed a similar arrangement with Excite for its Aptiva line of consumer PCs.—Maggie Overholt

MindSpring

\$19.95 per month for unlimited usage, plus \$25 setup fee (waived if you sign up online). MindSpring Enterprises, Atlanta; 888-877-7464; www.mindspring.net.

● In a little more than two years, MindSpring has grown from less than 300,000 customers to more than 1 million members. During that time, MindSpring has evolved into a well-rounded service with solid performance and features that will appeal to both individuals and business users of all levels.



Mindspring's start page, the Internet Desktop, offers more than just customized content.

When you launch MindSpring, you're greeted with the Internet Desktop. This displays content categories, notifies you of new e-mail, and lets you jump to your Favorites. And as with EarthLink's toolbar, you can add programs to the Internet Desktop toolbar for quick access. MindSpring lets its users choose between its home page or Snap as their starting point. MindSpring's page offers plenty of content from sources including CNN, Home-Arts, Lonely Planet Online, and S&P Personal Wealth.

The online help desk is a great resource for both consumer and business customers. A unique feature, the Call Center Snapshot page, lists the actual number of technical-support calls in queue and the estimated hold time.

The service includes one POP3 e-mail account and access to a server-based message filter called Spaminator. Members receive 5MB of server space for Web pages. Although MindSpring provides no templates or wizard-based authoring solu-

tions, it does bundle HotDog Express—a WYSIWYG authoring tool. And unlike any other ISP in this roundup, MindSpring provides a secure page where you can view statistics about your Web page and its visitors.

On the whole, MindSpring was a solid performer, posting scores above average in all performance categories except for call failure rates during the workday. Only AT&T WorldNet and Prodigy Internet delivered better performance.

MindSpring will soon expand its cable service (currently only available in Montgomery, Alabama) to Florida and Georgia, and the company recently completed its acquisition of Netcom, which offers DSL service in several metropolitan areas. MindSpring also provides ISDN access. Business Web hosting starts at \$26.90 per month for 15MB of server space. A range of e-commerce tools from shopping carts to full-blown online catalogs is also available.

MindSpring is a promising service with many attractive features—particularly for businesses. But for consumer dial-up access, we give the edge to AT&T WorldNet for its superior performance and support for multiple users.



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3-year limited warranty

Prices start at \$3,199

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*For more information, see www.hp.com/windows2000/desktop. **Estimated street price. Actual price may vary. Monitor not included.

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**HP Brio 7100 PC** Microtower model D7598T Intel® Celeron™ processor 366 MHz

4 MB RAM • 4.1 GB HD • 128 KB internal cache • SIS Super Audio 4 MB SDRAM • 3 PC I/O SA • 32x CD-ROM • Integrated PCI sound • Windows® 98

\$961***HP Brio BA PC** Microtower model D7586T Intel Celeron processor 400 MHz (shown left)

8 MB RAM • 8.4 GB HD • 128 KB internal cache • SIS Super Audio 4 MB SDRAM • 3 PC I/O SA • 32x CD-ROM • Integrated PCI sound • Windows 98

\$1,079***HP Vectra VE PC** Desktop model D6615T Intel Celeron processor 333 MHz

2 MB RAM • 12 MB ATA HD • 128 KB internal cache • A* Display Adapter 2 MB SDRAM • Windows 95

\$703***HP Vectra VE PC** Desktop model D6570T Intel Pentium II processor 350 MHz

32 MB RAM • 3.2 GB ATA HD • 512 KB internal cache • Matrix MCA Color Adapter 4 MB SDRAM • Windows 95

\$958***HP Vectra VL PC** Desktop model D8198T Intel Pentium II processor 400 MHz

8 MB RAM • 6.4 GB ATA HD • 512 KB internal cache • Matrix Pentium II VGA Adapter 4 MB SDRAM • 32x CD-ROM • Windows 95

\$1,363***HP Vectra VL PC** Desktop model D7535T Intel Pentium II processor 400 MHz

4 MB RAM • 4.1 GB ATA HD • 512 KB internal cache • Matrix Pentium II VGA Adapter 4 MB SDRAM • 10/100 Ethernet adapter • Windows NT 4.0 95

\$1,381***HP 70 17" Color Monitor D2837A**

17" flat square tube 15" viewable • Same depth as 15" monitor • Dot pitch 0.28 mm (vs. 0.24 mm horizontal) • 1280 x 1024 x 64 Hz • 1024 x 768 x 85 Hz • Full-range play 16 MB component • 32x CD-ROM • VGA to HP 9019 monitor 18" viewable \$200

\$325*



HP Brio BAx PC Microtower model D7603T Intel Pentium® II processor 350 MHz (shown left)
64 MB RAM • 8.4 GB HD • 512 KB internal cache • Matrox® MGA-G200 (8 MB SDRAM) • 3 PCI, 2 ISA, 1 combo • 32x CD-ROM • Integrated PCI sound • Windows 98

\$1,205*

HP Vectra VE PC Desktop model D6580T Intel Celeron processor 400 MHz
32 MB RAM • 3.2 GB UATA HD • 512 KB internal cache • Windows 95 • Matrox MGA-G100 AGP (4 MB SDRAM)

\$1,099*

HP Vectra VE PC Desktop model D6573T Intel Pentium II processor 350 MHz
64 MB RAM • 4.3 GB UATA HD • 512 KB internal cache • Matrox MGA-G100 AGP (4 MB SDRAM) • 32x CD-ROM • Windows 95

\$1,134*

HP Vectra VL PC Desktop model D5882T Intel Pentium II processor 400 MHz
64 MB RAM • 6.4 GB UATA HD • 512 KB internal cache • 32x CD-ROM • Matrox Productiva-G100 AGP (4 MB SDRAM) • Windows NT® 4.0/95

\$1,442*

HP Vectra VL PC Minitower model D7536T Intel Pentium processor 400 MHz
64 MB RAM • 6.4 GB UATA HD • 512 KB internal cache • Matrox Productiva-G100 AGP (4 MB SDRAM) • 32x CD-ROM • Windows NT 4.0/95

\$1,513*

HP Vectra VL PC Minitower model D6941T Intel Pentium II processor 450 MHz
64 MB RAM • 10.1 GB UATA HD • 512 KB internal cache • Matrox Productiva-G200 AGP (8 MB SDRAM) • DVD-ROM • 10/100 Ethernet adapter • Windows NT 4.0/95

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SUMMARY OF FEATURES

See www.pcmag.com for interactive views

Internet Service Providers



	America Online 4.0	AT&T WorldNet	CompuServe 2000	Concentric Network	EarthLink Sprint	MindSpring	MSN Internet Access 2.6	Prodigy Internet
Monthly price for unlimited access	\$21.95	\$21.95	\$19.95	\$19.95	\$19.95	\$19.95	\$19.95	\$19.95
Setup fees	None	None	None	None	\$25	\$25	None	None
Number of users per account	5	6	5	1	1	1	1	1
Browser included	MS Internet Explorer	MS Internet Explorer, Netscape Communicator	MS Internet Explorer	MS Internet Explorer, Netscape Communicator	MS Internet Explorer, Netscape Communicator	MS Internet Explorer	MS Internet Explorer	MS Internet Explorer
Number of POPs	Undisclosed	511	Undisclosed	350	More than 1,700	1,195	Undisclosed	Undisclosed
Basic hosting package	10MB	30MB	Info not available	5MB	6MB	5MB	None	2MB
Authoring tools	AOL Press, Personal Publisher	Personal Web Page Wizard, Web-page templates	Personal Publisher Wizard	Build Your Web Page Wizard	Claris Home Page Lite, Click-N-Build	HotDog Express	None	HTML templates
Consumer fast-access options	DSL, \$20/month extra (selected areas, later this year)	56K only	56K only	DSL, \$124-\$499/month (seven major metropolitan areas)	ISDN, \$34.95/month and up; cable access, \$35-\$40 (selected areas)	ISDN, \$6.95/month extra, \$25 setup	56K only	56K only

MSN Internet Access 2.6

\$19.95 per month for unlimited usage. Microsoft Corp., Redmond, WA; 425-635-7019; www.microsoft.com.

● Once a proprietary online service, MSN Internet Access has evolved into a standard Internet access provider. But with no Web hosting, fast-access options, or business services, MSN is the most limited of the ISPs we tested. And its network performance was generally below average. Although MSN does offer some attractive features, the service can't compete with well-rounded ISPs such as AT&T WorldNet.

During installation, MSN adds a unique QuickView tool to your Windows System Tray. QuickView lets you quickly connect and disconnect, jump to Favorites or MSN.com channels, execute searches, and change member settings. While you are connected, QuickView also indicates how long you've been online and whether you've received any new e-mail. MSN automatically detects LAN connections.

When you log on, you enter the OnStage area, which displays new e-mail messages and provides links to MSN.com channels and other Web sites. Microsoft plans to have eliminated the OnStage page by the time you read this, however, so users can connect directly to MSN.com.

Once you get to MSN.com, you'll find gems such as MSN CarPoint, MSN Expedia travel,

MSN HomeAdvisor for real estate services, and MSN MoneyCentral. Like other portals such as Excite, MSN.com lets you customize news, sports, and financial information, as well as display local weather, events, and news. Since MSN no longer offers premium content, however, you can access all of MSN.com without subscribing to the MSN dial-up service.

MSN comes with one e-mail account. Although it's not a POP3 account, MSN uses Outlook Express, which delivers all the rich features of a POP3 e-mail client. For additional e-mail accounts, MSN offers its Hotmail service free of charge to all Internet users.

MSN is the only ISP in this roundup that doesn't support personal Web pages. If you use MSN, you may opt for one of the free site-building communities such as Excite Communities or GeoCi-

ties (reviewed in "A Web Site of Your Own," April 6, 1999).

MSN was one of only two services (EarthLink was the other) to earn scores that were worse than average on all three call failure tests. Its download time and throughput scores were also worse than the average.

Microsoft is making some great contributions to the Web with its sophisticated content channels, but there are better ways to get at them than by using MSN Internet Access.

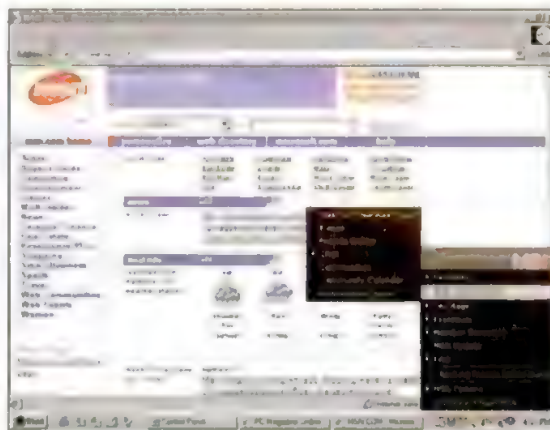
Prodigy Internet

\$19.95 per month for unlimited usage. Prodigy Communications Corp., White Plains, NY; 800-825-5667; www.prodigy.com.

● Once one of the big three online services, Prodigy Internet has changed with the times and continues to be a strong competitor. Like MSN, Prodigy has shed its proprietary service and has become a standard ISP. Now Prodigy differentiates itself by offering fast, reliable access to the Internet, online shopping discounts, and the ability to earn points towards selected merchandise. And Prodigy offers Web hosting and virtual office services for businesses.

During installation, Prodigy was the only service in this roundup that required us to configure mail settings manually. Once you get up and running, however, Prodigy provides excellent online support through its member center.

Unlike AOL and CompuServe, Prodigy no longer controls how and what content is



The QuickView applet provides one-click access to key features including e-mail and member settings.

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- MS Windows® 98/IntelliMouse®
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Business Lease^B: \$110/Mo., 36 Mos.

 **E-VALUE CODE: 04068-590332**

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- 12.9GB Ultra ATA Hard Drive
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- 40X Max™ Variable CD-ROM Drive
- Turtle Beach Montego A3D Sound
- ACS-295 Speakers with Subwoofer
- Iomega 100MB ZIP BUILT-IN Drive
- MS Office 97 SBE plus Bookshelf (Ask about Our *FREE* MS Office 2000 Upgrade Offer); McAfee VirusScan
- MS Windows 98/IntelliMouse
- 3-Year Limited Warranty†
- 1-Year NBD On-site^A Service
- ★ 6-Pak of Iomega 100MB Zip Disks, add \$79.

\$2499

Business Lease^B: \$84/Mo., 36 Mos.

 **E-VALUE CODE: 04068-590324a**

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- 12.9GB Ultra ATA Hard Drive
- 17" (16.0" viewable, .26dp) Trinitron 1000HS Monitor
- 8MB ATI XPERT 98D AGP Graphics
- 40X Max™ Variable CD-ROM Drive
- Yamaha XG 64V Wavetable Sound
- harman/kardon HK-195 Speakers
- 3Com USR V.90* PCI WinModem
- Iomega 100MB ZIP BUILT-IN Drive
- MS Office 97 SBE plus Bookshelf (Ask about Our *FREE* MS Office 2000 Upgrade Offer); McAfee VirusScan
- MS Windows 98/IntelliMouse
- APC SurgeStation Pro8T2
- 3-Year Limited Warranty†
- 1-Year NBD On-site^A Service

\$2179

Business Lease^B: \$73/Mo., 36 Mos.

 **E-VALUE CODE: 04068-590321**

NEW DELL DIMENSION XPS T450 PENTIUM III PROCESSOR AT 450MHz

- 96MB 100MHz SDRAM
- 512KB Integrated L2 Cache
- 12.9GB Ultra ATA Hard Drive
- NEW 17" (16.0" viewable, .26dp) M780 Monitor
- 8MB ATI XPERT 98D AGP Graphics
- 40X Max™ Variable CD-ROM Drive
- Yamaha XG 64V Wavetable Sound
- harman/kardon HK-195 Speakers
- 3Com USR V.90* PCI WinModem
- Trial Offer ConnectDirect Internet Access^C
- MS Office 97 SBE plus Bookshelf (Ask about Our *FREE* MS Office 2000 Upgrade Offer); McAfee VirusScan
- MS Windows 98/IntelliMouse
- 3-Year Limited Warranty†
- 1-Year NBD On-site^A Service

\$1899

Business Lease^B: \$64/Mo., 36 Mos.

 **E-VALUE CODE: 04068-590318**

DELL DIMENSION V400 PENTIUM II PROCESSOR AT 400MHz

- 64MB 100MHz SDRAM
- 512KB Integrated L2 Cache
- 8.4GB Ultra ATA Hard Drive
- NEW 17" (16.0" viewable, .26dp) M780 Monitor
- 8MB ATI 3D AGP Graphics
- 40X Max™ Variable CD-ROM Drive
- Yamaha XG 64V Wavetable Sound
- harman/kardon HK-195 Speakers
- Iomega 100MB ZIP BUILT-IN Drive
- MS Office 97 SBE plus Bookshelf (Ask about Our *FREE* MS Office 2000 Upgrade Offer); McAfee VirusScan
- MS Windows 98
- Dell QuietKey Keyboard
- Logitech First Mouse+ Wheel (PS/2v)
- 3-Year Limited Warranty†
- 1-Year NBD On-site^A Service
- ★ Upgrade to a NEW 12.9GB Ultra ATA Hard Drive, add \$69.

\$1579

Business Lease^B: \$53/Mo., 36 Mos.

 **E-VALUE CODE: 04068-590315**

DELL DIMENSION V333c INTEL CELERON® PROCESSOR AT 333MHz

Network-Designed Desktop

- 32MB SDRAM
- 128KB Integrated L2 Cache
- 8.4GB Ultra ATA Hard Drive
- 15" (13.8" viewable) 800F Monitor
- 8MB ATI 3D AGP Graphics
- 32X Max™ Variable CD-ROM Drive
- Integrated Intel 10/100 Ethernet
- MS Office 97 SBE plus Bookshelf (Ask about Our *FREE* MS Office 2000 Upgrade Offer); McAfee VirusScan
- MS Windows 98
- Dell QuietKey Keyboard
- Logitech First Mouse+ Wheel (PS/2v)
- Intel LANDesk® Client Manager v3.3
- 3-Year Limited Warranty†
- 1-Year NBD On-site^A Service
- ★ Upgrade to a NEW 17" (16.0" viewable, .26dp) M780 Monitor, add \$59.

\$1199

Business Lease^B: \$40/Mo., 36 Mos.

 **E-VALUE CODE: 04068-590311**

POWER UPGRADES

- Iomega 100MB ZIP BUILT-IN Drive with Two Disks, add \$99.
- 3Com USRobotics V.90* PCI Telephony WinModem, add \$49.
- 3Com 3C905B 10/100 NIC, add \$50.
- Intuit QuickBooks v6.0 Pre-installed, add \$118.
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DELL DIMENSION AWARD INFO

- In 1998, Dell Dimension desktops won more than 90 product and service awards. See www.dell.com/awards98 for details.
 - Winner of the 1998 PC Computing MVP "State-of-the-Art Desktop" (XPS R450) and "High-Performance PC" (XPS R400) awards.
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- 3D Surround Sound and HW Wavetable
- 12-Cell Intelligent Lithium Ion Battery
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- 3D Surround Sound and HW Wavetable
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- Microsoft Windows 98/Touchpad
- 3-Year Limited Warranty[†]

\$2699

Business Lease*: \$90/Mo., 36 Mos.

 E-VALUE CODE: 04069-890326

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- 3D Surround Sound and SW Wavetable
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- Internal 56K Capable® V.90 Fax Modem
- Trial Offer ConnectDirect Internet Access[†]
- MS Office 97 SBE (Ask about Our FREE MS Office 2000 Upgrade Offer)
- Microsoft Windows 98/Touchpad
- 3-Year Limited Warranty[†]

\$2299

Business Lease*: \$77/Mo., 36 Mos.

 E-VALUE CODE: 04069-890322

DELL INSPIRON 3500 A266XT PENTIUM II PROCESSOR AT 266MHz

Light Weight, Light Price

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- 32MB SDRAM (256MB Max)
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\$1999

Business Lease*: \$67/Mo., 36 Mos.

 E-VALUE CODE: 04069-890319

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Network-Optimized Notebook

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- Modular Floppy Drive
- NeoMagic MediaMagic 256AV AGP Video
- 3D Surround Sound and SW Wavetable
- Intelligent Lithium Ion Battery with 1-Hour ExpressCharge™ Technology
- Custom Leather Case
- MS Windows NT® Workstation 4.0
- Touchpad
- 3-Year Limited Warranty[†]
- 1-Year NBD On-site^Δ Service

\$3199

Business Lease*: \$87/Mo., 36 Mos.

 E-VALUE CODE: 04069-790331

DELL LATITUDE CPi D233ST PENTIUM II PROCESSOR AT 233MHz

Network-Optimized Notebook

- 12.1" SVGA Active Matrix Display
- 64MB EDO RAM (256MB Max)
- 4.3GB Ultra ATA Hard Drive
- Modular 24X Max^{AA} Variable CD-ROM
- Modular Floppy Drive
- NeoMagic 128-bit Graphics Accelerator
- 3D Surround Sound and SW Wavetable
- Intelligent Lithium Ion Battery with 1-Hour ExpressCharge Technology
- MS Windows NT Workstation 4.0
- Touchpad
- 3-Year Limited Warranty[†]
- 1-Year NBD On-site^Δ Service
- ★ MS Windows 98 Available, subtract \$85.

\$2399

Business Lease*: \$80/Mo., 36 Mos.

 E-VALUE CODE: 04069-890323

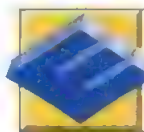
DELL NOTEBOOK AWARD INFO

- Inspiron 7000 A366LT – PC Magazine's Editors' Choice for small businesses, 1/99.

Advertised configurations vary from award-winning configurations.

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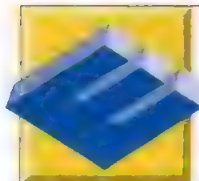
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Business Lease^o: \$425/Mo., 36 Mos

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\$5999

Business Lease^o: \$201/Mo., 36 Mos.

 **E-VALUE CODE: 04070-290359**

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- HP OpenView NNM Special Edition
- Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 6-1" Hard Drive Bays
- 4 Media Bays: 3-5.25", 1-3.5"
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\$5549

Business Lease^o: \$186/Mo., 36 Mos.

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DELL SERVER AWARD INFO

- *Network World* "World Class Award" – Dell PowerEdge 2300, 6/98.
- *Computer Shopper* "Top 100" – Dell PowerEdge 2300, 11/98.
- *PC Computing's* "The 'A' List" – Dell PowerEdge 6300, 11/98.
- *LANTIMES* "The Best of LANTIMES Over \$25,000" – Dell PowerEdge 6300, 9/98.
- *ComputerWorld's* "Leaders' Choice" Winner Workgroup Servers – Dell PowerEdge Family, 1/98.

Advertised configurations vary from award-winning configurations

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- HP OpenView NNM Special Edition
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\$3949

Business Lease^o: \$132/Mo., 36 Mos

 **E-VALUE CODE: 04070-290339**

DELL POWEREDGE 2300 SERVER PENTIUM II PROCESSOR AT 350MHz (DUAL PROCESSOR/RAID CAPABLE)

- 64MB 100MHz ECC SDRAM
- 4GB Ultra-2/LVD SCSI Hard Drive (Hot-Swap Optional)
- HP OpenView NNM Special Edition
- Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 4-1.6" or 6-1" Hard Drive Bays
- 4 Media Bays: 3-5.25", 1-3.5"
- 3-Year NBD On-site^a Service
- 7x24 Dedicated Server Hardware Technical Telephone Support
- ★ Upgrade to a Pentium II Processor at 400MHz, add \$300.
- ★ MS Windows NT Server 4.0 (10 Client Access Licenses), add \$799.

\$2349

Business Lease^o: \$79/Mo., 36 Mos.

 **E-VALUE CODE: 04070-290323**

NEW DELL POWEREDGE 1300 SERVER PENTIUM II PROCESSOR AT 350MHz (DUAL PROCESSOR/RAID CAPABLE)

- 64MB 100MHz ECC SDRAM
- 4GB Ultra-2/LVD SCSI Hard Drive
- HP OpenView NNM Special Edition
- Integrated PCI Ultra-2/LVD SCSI Controller
- 6 Expansion Slots: 5 PCI, 1 PCI/ISA
- 4 Hard Drive Bays: 2-1.6" and 2-1"
- 3-5.25" Media Bays
- 3-Year NBD On-site^a Service
- 7x24 Dedicated Server Hardware Technical Telephone Support
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- ★ Upgrade to a 9GB Ultra-2/LVD SCSI Hard Drive, add \$200.

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 **E-VALUE CODE: 04070-290318**

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- 3Dlabs Oxygen GMX 2000 Graphics Card
- 40X Max™ Variable CD-ROM Drive
- Sound Blaster Pro Compatible Sound
- Integrated 3Com® 10/100 PCI NIC
- Remote Client Manageability Support via DMI 2.0; Wakeup on LAN Capable
- MS® Windows NT® 4.0 and 1-Year NT Telephone Support
- 3-Year NBD On-site^a Service
- 7x24 Dedicated Hardware Tech Support

\$6449

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 **E-VALUE CODE: 04071-490364**

NEW DELL PRECISION WORKSTATION 410 PENTIUM III PROCESSOR AT 500MHz (Dual Processor/ RAID Capable)

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- 512KB Integrated L2 Cache
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- Sound Blaster Pro Compatible Sound
- Integrated 3Com 10/100 PCI NIC
- Remote Client Manageability Support via DMI 2.0; Wakeup on LAN Capable
- MS Windows NT 4.0 and 1-Year NT Telephone Support
- 3-Year NBD On-site^a Service
- 7x24 Dedicated Hardware Tech Support

\$3349

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 NEW 1GBD 278 nVidia GTX 5D AGP Graphics Card

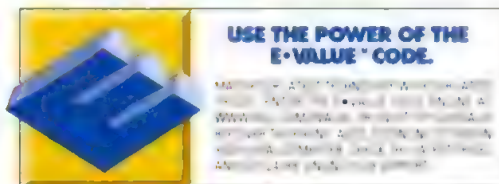
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THE REGIONAL PICTURE

THE BIG NATIONAL ISPs reviewed in our main story have the largest numbers of subscribers, but those numbers don't tell the whole story. There are an estimated 5,000 ISPs in the U.S., and many are regional or local operations.

Many users are turning to regional providers hoping for fast-access options, better customer support, less congestion on e-mail servers, and conveniences such as integrated billing packages. But there are some drawbacks. The most obvious is that if you travel often, you may find yourself making long-distance calls to gain access. Here are three of the largest regional ISPs, representing three areas of the country.

With a simple installation and monthly charges that can be added directly to your phone bill, BellSouth.net offers easy, convenient Internet access. Meanwhile, businesses will appreciate the breadth of services, including relatively inexpensive ADSL connections.

For \$19.95 per month, BellSouth.net provides unlimited Internet access, a copy of Netscape Communicator 4.04, and a mix of content from partners. Provisions for personal home pages are subpar. Consumers must pay an additional \$1.95 per month for 2MB of server space, and no custom templates or upload capabilities are included. BellSouth.net's business program is more impressive. There are four plans, ranging from \$14.95 to \$99.95 per month. All include HTML templates. Shared hosting packages range from \$29.99 to \$129.95 per month.

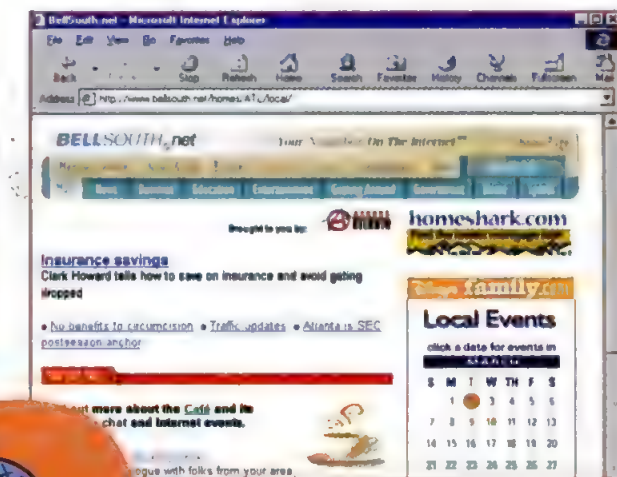
For faster connections, BellSouth.net offers ADSL access for about \$60 a month. Meanwhile, road warriors will appreciate connecting on the road for 10 cents per minute. BellSouth.net's free telephone assistance is available 24 hours, 7 days, and has short waiting periods. Our average wait time was under 8 minutes. (BellSouth.net; 800-436-8638; www.bellsouth.net.)

With extensive K56flex service throughout California and U.S.-wide roaming service, Pacific Bell Internet Services (PBIS) blurs the line between regional and national ISPs.

The PBIS software includes a customized version of Netscape Communicator 4.04. Users are allowed up to three POP3 mailboxes and two e-mail aliases. Most of PBIS's content is provided by



Regional ISPs such as BellSouth.net provide some advantages over big, national ISPs.



Snap (www.snap.com). Members receive 3MB of server space for personal Web pages, as well as simple templates for creating an online résumé and home page.

PBIS offers ISDN connectivity at most of its locations and DSL in some areas. And for the traveler, PBIS supports more than 500 roaming locations across all 50 states for 4 cents per minute. (Pacific Bell Internet Services; 800-436-8638; www.bellsouth.net.)

RCN, which claims to be the largest regional ISP in the U.S., is currently available in the Northeast and plans to add service in California later this year. The monthly \$19.95 charge includes unlimited connect time, one mailbox, 1MB of server space for a Web page, and support for V.90 modems and one-channel ISDN. For an extra charge, RCN lets you add more mailboxes and Web space.

RCN's software includes your choice of Microsoft Internet Explorer 4.0 or Netscape Communicator 4.0 on CD-ROM. Setup is surprisingly easy, with wizards that install and set up the browser and automatically set up a Windows Dial-Up Networking definition. In case you run into trouble, however, toll-free technical support is available around the clock.

In addition to the standard connection types, RCN supports two-channel ISDN, T1, and T3 lines. Cable modem service is available in some areas. (RCN, 800-746-4728; www.rcn.com.)

—Robert Lipschutz, Jan Ozer, and M. David Stone

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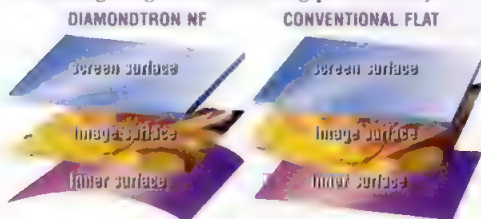
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Crisp...Thin...But Cheap Enough?

By Alfred Poor

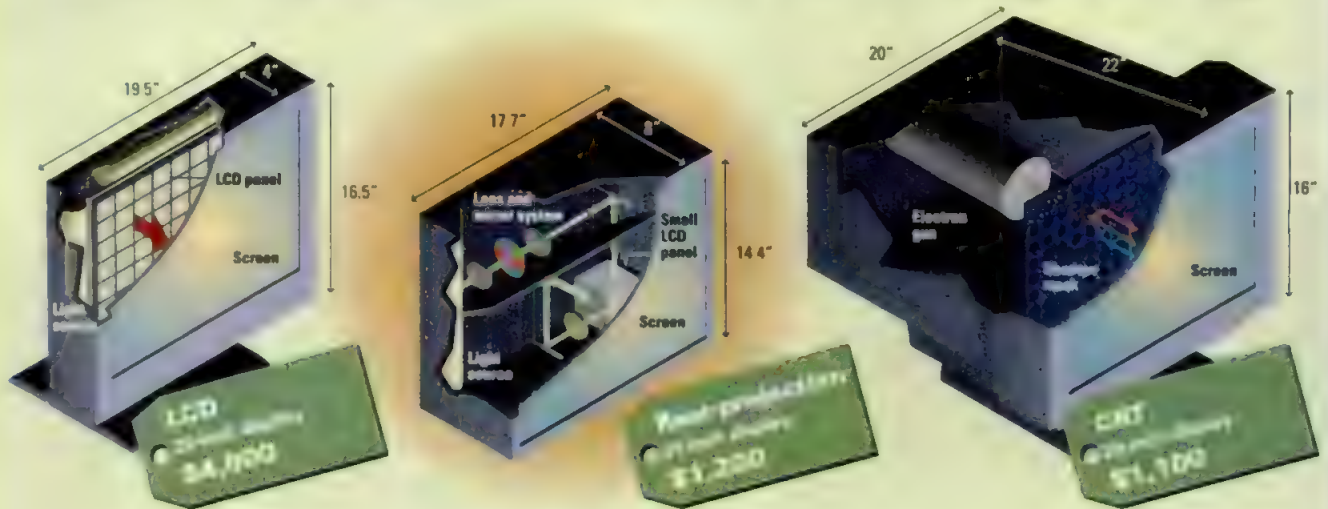
There's no doubt about the appeal of an LCD monitor for desktop use: A few inches deep and a mere 15 pounds, a 15-inch LCD monitor has about the same viewable area as a 17-inch CRT, which eats up 18 inches of desktop space and weighs 40 pounds. And since you get laser-crisp text on an LCD screen, what could possibly stand in your way? Price. With street prices typically ranging from \$850 to \$1,300 (the price of a good entry-level PC), a 15-inch LCD monitor is an extra expense that can be hard to justify when an excellent 17-inch CRT monitor can be had for \$500 or less. But many buyers are ready to make the switch, swayed by LCD's benefits: sharp text, svelte profile, lower power consumption, less heat generation, and no VLF or

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Rear-Projection LCD: The Next Big Thing?



Although prices for LCD monitors have dropped significantly in the past two years, some industry watchers wonder how much lower they can go. Component makers (such as Pixelworks and Sage Electronics) will release more highly integrated controller chips this year, which will help monitor makers shave costs. But prices for the panels themselves—the most expensive of the components—have stabilized and may even increase. The complexity of the panels is to blame. Competition to direct-view LCD on the desktop may come from rear-

projection LCD monitors. This new breed of desktop displays, expected to begin appearing by year's end, uses small (0.33-inch) LCD panels in conjunction with a series of lenses and mirrors to project an image onto a translucent screen from behind—much like today's data projectors or projection televisions. The units are deeper than LCD monitors (about 8 inches), but their relative simplicity means that a 20-inch model could cost around \$1,200 once volume ramps up, versus \$1,100 for a comparable CRT and \$4,000 for a 20-inch direct-view LCD.

ELF emissions to raise health concerns.

For this roundup, we tested only 15-inch models because they are roughly equivalent in screen real estate to the 17-inch CRTs that have become the standard on business desktops. Each vendor was asked to send one analog and one digital model, and we permitted NEC Technologies (the market leader) to submit two analog models. We also included a unique wide-format unit from Number Nine/Silicon Graphics: Targeted at the workstation market, this 17.3-inch model is sized—and at \$2,500, priced—closer to an 18-inch LCD.

Small size has always made LCD monitors popular in settings, such as financial and medical installations, where space is at a premium. But a number of other factors are in their favor. LCD monitors are *direct-address* displays, which means that each pixel corresponds to a physical display component in the panel. Consequently, images are displayed with greater precision than in a CRT. And since the LCD cells

are always in perfect alignment and position, there are no problems with screen geometry (such as pincushion distortion) or convergence error, which occurs when an imperfect electron beam creates halos around the edges of an on-screen object.

ANALOG OR DIGITAL?

One of the biggest differences among the LCD monitors is how they connect to your computer: by a standard *analog* interface or by one of the new *digital* standards.

Most LCD monitors (in fact, 23 of the 29 here) rely on an analog connection, the same used by any standard VGA/SVGA graphics adapter and CRT combination. This makes connecting a new LCD to any existing PC system easy. On the downside, such a connection requires the original digital signal to be converted to analog at the graphics card and then back to digital again in the monitor. This circuitry increases cost, and the conversion can result in loss of picture quality and in *pixel jitter*—a

shimmering effect (sometimes called *pixel swim*) that occurs when the panel can't decide which of two adjacent cells should be turned on. Though the monitors include circuitry and controls to correct it, the jitter can't always be eliminated fully.

By comparison, a digital interface monitor has none of these problems. The pixel that is defined as *on* at the graphics card is turned on at the panel, no doubt about it. This eliminates all image-size, position, and pixel-jitter problems. So, since the image quality is clearly superior, why hasn't digital taken off?

For one thing, a digital LCD monitor requires a graphics adapter with a digital signal connection. So you must replace your existing graphics card with a new one (typically available in a bundle from the monitor vendor), which adds about \$100 to the cost and increases installation complexity. Moreover, while digital interface cards are becoming more common (as are models with both analog and digital connections), there are still relatively few to choose from. So if you picked a particular analog card for a specialized purpose—OpenGL or high-end gaming, for example—the digital cards offered might not

Our Contributors: ALFRED POOR, BRUCE BROWN, and M. DAVID STONE are contributing editors of *PC Magazine*. JOSH LEVY is the staff editor for the hardware peripherals team. JEFF SACILOTTO and S. JAE YANG were the labs project leaders, and senior associate editor JAMIE M. BSALES was in charge of this story.

suit your performance needs.

Second, confusion in the marketplace about which digital specification would eventually prevail slowed down the adoption of digital on the PC end. From an alphabet soup of contenders—DFP, P&D, LVDS, TMDS, DISM—a winner seems to have emerged. The Digital Display Working Group's new Digital Visual Interface (DVI) specification allows for both digital and analog support on the graphics card. All of the digital monitors here (save one) follow the PanelLink standard, from which DVI stemmed. The Number Nine/SGI entry uses LVDS, which Number Nine and SGI claim better delivers the higher resolution (1,600-by-1,024) of the wide-aspect panel, though they may move to DVI also.

TURNING HEADS

Beyond whether its interface is analog or digital, the most significant feature to consider is whether the monitor's screen can pivot between landscape and portrait modes (as nine of the models we tested can). Standard displays are wider than they are tall. This *landscape* orientation is fine for spreadsheets and games. But e-mail, word processing, and Web-page viewing generally lend themselves to the vertical (or *portrait*) orientation, which resembles printed documents. Thus some monitors are made to rotate 90 degrees, from landscape to portrait mode, to display a full page at a time.

The pivot feature, originally developed for PC CRT monitors by Portrait Display Labs, didn't catch on; but now it's better suited to the light weight and slim size of LCD panels. Note, however, that because graphics chips were designed to redraw an image in landscape rather than portrait mode, graphics performance suffers somewhat (from 10 to 45 percent), which means slower window redraws and the like. But for most business users, having more of a document on the screen at one time is worth the performance hit.

Other differentiating features to consider, depending on your needs and budget, are built-in stereo speakers and microphones (13 of the models here have them), powered USB hubs (included or offered as an option on another 13), and Kensington lock slots (on 10 models) to prevent theft of the lightweight panels.

NOT FOR EVERYONE

As good as they are, LCD monitors are not for everyone. They are designed to work best at their native resolution: 1,024-by-768 for the 15-inch models here. While most can scale up lower resolutions, the image quality of a scaled image varies widely. Also, while CRTs can easily produce a smooth and wide range of shades from dark to light, many LCD monitors are limited in their abilities at the darkest and lightest shades, making them less suitable for graphics work. And LCD panels are not as fast to react as CRTs, which can result in smearing motion artifacts in video clips or animations.

There are some clouds on the horizon for LCD monitors. Last year, buyers enjoyed an oversupply of LCD panels, which helped drive prices down. This year, projections indicate that the surplus may turn into a shortage as demands for larger panels effectively reduce the worldwide manufacturing capacity. Manufacturers admit that 20 to 30 percent price increases

for the raw panels may occur this year, though most indicate that they hope to hold their prices steady for the finished LCD monitor products. Regardless of whether they can hold the line, don't expect to see any further dramatic price drops this year.

For drama, watch the technologies competing to take advantage of this price pressure on LCD monitors. One of the hot tickets is rear-projection desktop monitors. Similar in design to a large home-entertainment rear-projection display, these will be in the 21-inch-diagonal range, with SXGA resolution or better. About 6 to 8 inches deep, they will weigh about the same as LCD monitors of similar size. One source indicated that a 21-inch rear-projection monitor might be available for \$1,200 (about the same price as a good 21-inch CRT) within the next 12 months—versus \$4,000 for a 20-inch LCD monitor.

But if you're not the type who deals well with delayed gratification, then feast your eyes on the LCD monitors that are available now.

Editors' Choice

- Digital: IBM T55D
- Analog: MAG Innovision LT541C



If you're upgrading to an LCD monitor, our advice is to go all the way and trade up to a digital-interface model: The image quality is noticeably better

than even the best analog equivalent.

The best of the 29 LCD monitors we tested, and our Editors' Choice for those willing to commit to digital, is the IBM T55D. Image quality is flawless, with no pixel jitter, and the T55D produces saturated, accurate colors and even, smear-free video. Unlike those of most LCD monitors, images at nonnative resolutions are also very good, and the pivot feature is a nice bonus. You can buy the T55D with a Matrox digital interface card as a bundle from IBM (a reasonable \$1,100 street) or opt for the monitor alone (\$950) and supply a different digital card.

Just a step behind the IBM in image

quality, the digital Toshiba TekBright 50D (\$1,300 with card), which also delivers a solid picture and pivot, merits an honorable mention.

If you prefer the flexibility and setup ease of an analog monitor, our Editors' Choice for analog is the MAG Innovision LT541C (\$850). The monitor delivers fine image quality, and its low price belies the high-end features it includes: pivot and a four-port USB hub. Honorable mention goes to the LG Electronics 500LC (\$1,000), which delivered the best overall image quality among the analog monitors we tested.

The analog models from Compaq, Dell, Optique, and Sony, while not as outstanding as the MAG and LG, deliver good images and are worth a look.

AcerView F51

\$1,000 street. San Jose, CA; 800-379-2237; www.acerperipherals.com.

● Acceptable but not outstanding for general office use, the analog AcerView F51 revealed a loss of color differentiation in darker shades in DisplayMate testing, caused by brightness and contrast settings that were impossible to balance. As a result, it's not particularly well suited to demanding graphics and color applications.

The F51 has a unique and convenient *i* key control button that recalibrates pixel frequency, horizontal and vertical image position, and color temperature whenever the PC's display mode is changed. Default settings didn't eliminate pixel jitter, though phase control adjustment corrected the problem. But for the price, we preferred the image quality of the Dell, MAG Innovision, and Optique models reviewed here.—Bruce Brown

ADI MicroScan 6L

\$940 street. San Jose, CA; 800-228-0530, 408-944-0100; www.adiusa.com.

● Though the ADI MicroScan 6L's text image quality is merely acceptable, its fine photo and video images may sway more graphics-intensive users.

Setup was simple, and we easily eliminated most moiré and jitter with the intuitive on-screen display. In our labs, the real problem was a bit of ghosting: Thin, dark lines on a white background often had white afterimages just to their right, creating a blurred effect and a problem with text. In its favor, the MicroScan effectively produced subtle shades, and motion video was better than that of most we tested. So it's worth a look for graphics-oriented buyers.—Josh Levy

Advan AGM15T

\$1,000 street. Fremont, CA; 888-786-1688; www.advancorp.com.

● The Advan AGM15T is a perfectly acceptable analog monitor for business chores though not a standout for its price. The DisplayMate test patterns turned up several image problems (streaking, jitter), but these were minor enough that you'd probably not notice them in real-world use.

The monitor delivered one of the best contrast ratios in this batch (368:1) and excellent text image quality. Full-motion



To determine the **ease of setup** rating, we take into account how quickly we are able to get the monitor up and running.

Do we have to fiddle extensively with the controls to get a usable image?

Since most of these monitors will be used for business applications, **text image**

quality is paramount. We look for crisp, well-formed characters even at small type sizes, with no ghosting. The ability to scale to a nonnative resolution and still maintain good text quality is a plus.

An area where LCDs still trail CRTs is **video image quality**. But better LCDs can deliver rich, accurate colors while producing a relatively smooth video image, free of the streaking and ghosting that characterized early LCDs.

	Price	Ease of setup	Text image quality	Video image quality
AcerView F51	\$1,000	Good	Fair	Good
ADI MicroScan 6L	\$940	Good	Fair	Good
Advan AGM15T	\$1,000	Good	Excellent	Fair
Argon TP15	\$950	Good	Good	Fair
Compaq TFT5000	\$1,200	Fair	Excellent	Good
Dell 1500P	\$1,000	Good	Excellent	Good
EIZO-Nano FlexScan L360	\$1,240	Good	Good	Fair
Hitachi SuperScan LC150	\$1,350	Fair	Good	Fair
EDITOR'S CHOICE IBM T550*	\$950	Good	Excellent	Excellent
Iiyama Pro Lite 388	\$1,130	Fair	Good	Fair
KDS VS-F15	\$900	Fair	Poor	Poor
LG Electronics 500LC	\$1,000	Good	Excellent	Excellent
EDITOR'S CHOICE MAG Innovision LTM1C	\$850	Good	Excellent	Fair
NEC MultiSync LCD1500M	\$1,000	Fair	Good	Good
NEC MultiSync LCD1510	\$1,000	Good	Fair	Fair
Nokia 500Xa	\$1,520	Fair	Fair	Fair
Number Nine DFP/SGI 1600SW*	\$2,500	Good	Excellent	Fair
Optique L700	\$980	Good	Excellent	Good
Panasonic PanaFlat LC505	\$1,000	Good	Good	Good
Princeton DPP500*	\$1,000	Fair	Excellent	Fair
Preview PT-500	\$890	Fair	Poor	Fair
Samsung SyncMaster 530TFT	\$1,090	Good	Good	Good
Sanyo LMU-TP150A1	\$1,300	Fair	Good	Fair
Sceptre BT15+	\$1,000	Fair	Good	Fair
Sceptre BT15D+	\$1,100	Good	Excellent	Fair
Sony CPD-L150	\$1,400	Good	Excellent	Good
Toshiba TekBright 500	\$1,300	Good	Excellent	Good
ViewSonic VPA150	\$950	Good	Excellent	Fair
ViewSonic VPD150*	\$1,000	Excellent	Excellent	Fair

* Digital interface model, tested with the graphics card the vendor offers as an option

video wasn't as smooth as it should have been but better than that of some other LCDs. Ultimately, the AGM15T isn't a match for monitors like the MAG Innovision or Optique models, which cost less. But if you find the Advan at a low price, it's worth considering.—M. David Stone

Argon TP15

\$950 street. Santa Fe Springs, CA; 310-727-5500; www.argontechnologies.com.

● Argon Technologies' analog TP15 comes equipped with 2-watt stereo speakers and a microphone. It delivers good text performance, but the display suffers

from noticeable color problems, making it a better choice for business use than for graphics or video applications.

In our labs, text and fine detail were sharp and clear, aided by one of the highest contrast ratios in the group (374:1). But the darkest black shades were strikingly green in hue, and on the DisplayMate color ramp test, we saw harsh stepping instead of smooth gradations. Some grayscale screens also showed unresolved pixel jitter. The TP15 is a fine business monitor, but we found better overall image quality in similarly priced units from LG Electronics and MAG Innovision.—JL

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Specializing in flat-panel market research and analysis, DisplaySearch posts information on the latest market developments in flat-panel displays. The site also includes information on flat-panel companies and their products, and links to Web sites that cover this segment of the industry.

► Sonera Technologies' DisplayMate

www.displaymate.com

If you're serious about evaluating an LCD (or a CRT) monitor, use the same tools we do. This site contains working demos of the DisplayMate video-diagnostic utility, plus tips on purchasing and fine-tuning your monitor.

Compaq TFT5000

\$1,200 street. Houston, TX; 800-345-1518; www.compaq.com.

● The Compaq TFT5000 delivers good image quality and the ability to pivot between landscape and portrait modes. It's a strong contender for business buyers. We turned up a few minor problems in the DisplayMate tests, including a slight jitter and an obvious green tint in dark shades of gray. These may show up in real-world graphics, but they shouldn't be an issue for business applications. We also measured a very good contrast ratio of 302:1 and some of the widest viewing angles in the roundup.

The heavy-duty base lets you adjust the height of the monitor as well as pivot it. The on-screen menus are straightforward, but they rely on only three buttons that are a little confusing to use at first. On the whole, the TFT5000 is a fine choice if you're willing to pay a little more to get the Compaq name and the pivot feature.—MDS

Dell 1500FP

\$1,000 direct. Round Rock, TX; 800-388-8542; www.dell.com.

● The Dell 1500FP is a good choice for most applications and should be on your short list if you want an analog monitor.

Our test unit showed very high image quality. Minor screen jitter was easily corrected with the phase adjustment. Balancing brightness and contrast controls made it difficult to discern darker shades of colors, though changes between shades were gradual.

Dell includes a manual which, oddly, makes no mention of the bundled disk that includes INF and ICM files and an impressive automatic configuration utility. You can add a convenient USB hub for just \$50. And current Dell users will appreciate the rotary dial navigation control similar to those on the Dell CRT models. If you are sticking with analog, the 1500FP is a good bet.—BB

EIZO-Nanao FlexScan L360

\$1,240 street. Cypress, CA; 800-800-5202, 562-431-5011; www.eizo.com.

● The EIZO-Nanao FlexScan L360 is relatively expensive for an analog LCD monitor. You do get a built-in USB hub for your investment, but merely acceptable image quality makes the price tough to justify.

The contrast ratio was an excellent 345:1, and the measured viewing angles were better than average. However, we saw a number of flaws on the DisplayMate tests, including streaking, jitter at low intensities, and a slight yellow-green tint on dark shades of gray. You can overlook these flaws in business applications, but they may be a problem if you work with graphics. Note, too, that full-motion video was somewhat blurrier than with most other LCDs. All in all, we preferred the analog entries from Dell and MAG Innovation.—MDS

Three mainstream analog LCDs from Advan, LG Electronics, and Acer Peripherals.

Hitachi SuperScan LC150

\$1,350 street. Westwood, MA; 800-441-4832, 781-461-8300; www.nsa-hitachi.com.

● Brilliant color, easy-to-use controls, top-notch brightness and contrast ratio, and stable, flutter-free screens make the

analog Hitachi SuperScan LC150 a good choice for a variety of uses.

The LC150 needed significant adjusting to eliminate moiré and pixel jitter problems. But after adjustment, we found the screen marvelously stable, with crisp, vivid text and virtually no ghosting. The LCD150 oversaturates black levels, however: There was no way to make subtle, dark-toned gray scales visible, and they remained indistinguishable from pure black. In short, this is a good display, though pricier than most in this class.—JL

IBM T55D

\$1,100 street with digital video adapter, \$950 without. Research Triangle Park, NC; 800-426-7255 ext. 4753; www.ibm.com/pc/us/accessories/monitors.



The charcoal-color IBM T55D is a knockout. It's attractive both for price and performance and is our Editors' Choice among digital interface models.

The Matrox video card (which we installed without incident) that IBM offers with the unit is based on a graphics chip that delivers a strong 2-D performance for business, though only adequate acceleration for 3-D gaming. The T55D ran the gauntlet of DisplayMate tests without a flaw. And unlike so many other LCD models, the T55D scaled to 800-by-600 resolution with no noticeable faults. On the whole, this is a brilliant display that offers one of the best deals in the roundup.—BB



Iiyama Pro Lite 38B

\$1,130 street. Costa Mesa, CA; 800-394-4335; www.iiyama.com.

● The Iiyama Pro Lite 38B is loaded with features—including two 1-watt stereo speakers as well as one upstream and four downstream USB ports—but its merely



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PERFORMANCE TESTS

LCD Monitors



On these objective tests, which complement our reviewers' visual inspections, the Hitachi SuperScan LC150 displayed the highest brightness and the best contrast ratio, while the

AcerView F51, the Sceptre BT15+, and the Sceptre BT15D+ units boasted viewing angles comparable to those of CRT monitors. The data captured with the Microvision SS220 analyzer is an important and valid indicator of some aspects of LCD monitors' display quality. The numbers we report here, however, must be considered within the context of our reviewers' evaluation of visual quality, based on real-world applications and test patterns from Sonera Technologies' DisplayMate inspection utility (www.displaymate.com).

We gauged each monitor's brightness by sending a white signal of the maximum RGB value (255, 255, 255) and measuring the display's luminance in candelas per square meter (cd/m²). All of the LCD monitors surpassed the reference CRT monitor in maximum brightness.

The contrast ratio is the luminance difference between the display of the white (255, 255, 255) RGB signal and the black (0, 0, 0). A high contrast ratio is conducive

to text that's crisp and easy to read, and it also produces a vivid tonal range of colors. More than half of the LCD monitors achieved a better contrast ratio than the CRT reference monitor.

The viewing angles were measured in two ways: by tracking the change in contrast ratio and by observing the color shift at various angles. We report the viewing angles in both the horizontal (side to side) and vertical (up and down) directions. For

the contrast ratio aspect of the test, we measured the angle (in degrees) until the contrast ratio fell below 10:1. For color, we measured until a noticeable color shift occurred, using the industry-standard measurement of Delta-E to track color differences. A value difference of 1 Delta-E is a barely noticeable difference between two colors; a color shift of 5 Delta-E is readily noticeable by most people.

In general, the current crop of LCD monitors performed almost as well as the CRT reference monitor in maintaining the contrast ratio over a wide viewing angle. The big difference was in the color shift. While colors on the CRT reference monitor appeared the same over a wide angle of view (120 degrees in the horizontal direction and 125 degrees in the vertical), the colors displayed on most LCD monitors changed drastically even at angles slightly off the normal angle.—*Analysis written by S. Jae Yang and Jeff Sacilotto*

High scores are best.
Bold type denotes first place among reviewed products.
■ denotes Editors' Choice.

	Brightness	Contrast Ratio	Horizontal Viewing Angle Degrees to noticeable shift (contrast) (color)		Vertical Viewing Angle Degrees to noticeable shift (contrast) (color)	
AcerView F51	163	263:1	140	115	140	125
ADI MicroScan GL	183	212:1	120	50	120	15
Advan AGM15T	218	388:1	135	78	115	16
Argon TP15	226	374:1	130	60	115	20
Compaq TFT5000	227	277:1	125	50	100	10
Dell 1500P	178	338:1	135	70	115	15
EIZO-Nano FlexScan L360	197	345:1	130	60	110	16
Hitachi SuperScan LC150	308	431:1	140	105	140	60
■ IBM T550	226	199:1	125	50	120	20
Iiyama Pro Lite 38B	190	270:1	135	60	100	35
KDS VS-F15	185	129:1	110	60	85	15
LG Electronics 500LC	179	217:1	125	60	100	10
■ MAG Innovation LT541C	189	306:1	125	75	110	15
NEC MultiSync LCD1500M	155	192:1	140	55	140	55
NEC MultiSync LCD1510	173	306:1	125	60	95	15
Nokia 500Xa	216	338:1	110	50	90	20
Number Nine DFP/SGI 1600SW	227	343:1	130	65	100	20
Optique L700	165	242:1	125	60	110	10
Panasonic PanaFlat LC50S	128	218:1	115	50	90	15
Princeton DPP560	173	329:1	135	70	115	25
Proview PT-500	185	219:1	120	45	115	15
Samsung SyncMaster 530TFT	234	208:1	125	55	115	15
Senyo LMU-TF150AJ	209	270:1	115	40	100	15
Sceptre BT15+	218	215:1	140	70	140	105
Sceptre BT15D+	241	202:1	140	70	140	100
Sony CPD-L150	180	239:1	120	60	105	15
Toshiba TekBright 50D	186	319:1	135	85	110	10
ViewSonic VPA150	196	340:1	110	50	100	15
ViewSonic VPD150	200	336:1	140	70	115	15
Hitachi SuperScan MC 611*	77	245:1	140	120	140	125

* CRT monitor, reported for comparison

On our **Brightness** test, the Hitachi SuperScan LC150 was the brightest of the batch at 308 cd/m². The Sceptre BT15+ was a distant second at 241 cd/m². Impressively, the Hitachi monitor achieved the best brightness without sacrificing **Contrast Ratio**, where it was also the leader. The KDS VS-F15 trailed on the contrast ratio test, with the lowest ratio, 129:1. Eight monitors delivered the widest **Horizontal Viewing Angle** (for contrast) that we could test (140 degrees), and six hit the maximum in the **Vertical Viewing Angle**. The only LCD monitors with CRT-like viewing angles with respect to color were the AcerView F51 and the two entries from Sceptre. Not coincidentally, each of these monitors uses a Fujitsu panel.

average image quality makes it less desirable than other analog models we tested.

The unit performed well on our Horizontal Viewing Angle test and placed mid-pack everywhere else. DisplayMate tests revealed noticeable jitter in the monitor's default settings that couldn't be entirely rectified. The 38B's screen also had diffi-

culty differentiating dark levels of colors, making it less desirable for high-end color applications. We saw no pixel defects, but iiyama's policy—less generous than many—is to replace monitors during the three-year warranty period only if seven or more pixels are defective, and only if at least two of those are adjacent.—BB

KDS VS-F15

\$900 street. Garden Grove, CA; 800-237-9988; www.kd-susa.com.

● The KDS VS-F15 was a disappointing performer on our tests. Its score on our Contrast Ratio test was among the lowest we saw, and its showing on our Brightness

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and Viewing Angle tests was below average. Worse, the unit supports only up to 16-bit color depth, which put it at a disadvantage. In DisplayMate testing, we observed color blotching and jitter that couldn't be eliminated. Models from MAG Innovision and Optquest deliver better image quality at similar prices.—*BB*

LG Electronics 500LC

\$1,000 street. Englewood Cliffs, NJ; 201-816-2000; www.lgeus.com.

● A fine choice for mainstream business markets, the LG Electronics 500LC is one of the better analog monitors we saw. It should be on your short list.

User controls are positioned under the front edge for a clean look. Conveniently, brightness is directly adjustable with the control buttons; less-used adjustments are available via an on-screen menu. Brightness and contrast were well controlled, with graduated steps of dark shades clearly discernable. There was no noticeable streaking or ghosting, and the minor jitter was easily corrected with phase adjustment. Its score on our Contrast Ratio test was below average, but we found its contrast fine for typical business chores. On the whole, the monitor turned in admirable image quality at an attractive price.—*BB*

MAG Innovision LT541C

\$850 street. Irvine, CA; 800-827-3998, 949-855-4930; www.maginnovision.com.



The MAG Innovision LT541C is a budget-priced monitor that delivers solid image quality and a host of high-end features. It's our Editors' Choice for an analog LCD monitor.

Unlike others in its price class, the LT541C is loaded: It can pivot between landscape and portrait modes, and has a USB hub with one upstream and four downstream ports. On our tests, the monitor did a good job of showing distinct levels of brightness in both light and dark shades (although it handled this better in landscape mode than portrait mode). Its auto-adjust option set landscape mode for minimum jitter with ease. The only

real image quality issue was that color was a little less saturated than it could be, with yellow and green in particular tending towards pastel shades. All told, the LT541C is an impressive monitor for the price.—*MDS*

NEC MultiSync LCD1500M, LCD1510

LCD1500M: \$1,000 street. LCD1510: \$1,600. Itasca, IL; 800-632-4636; www.nectech.com.

● These two analog NEC offerings are good but not standout units. The LCD1510 rotates 90 degrees so you can view the image in portrait or landscape mode, and NEC's XtraView technology—which performs in-plane LCD switching—increases the viewing angle dramatically.

Setup was fairly easy,



More analog LCDs: the pivot-enabled NEC 1510, plus units from Panasonic, Sony, and Samsung.

and the automatic synchronizing feature did an excellent job of setting the image size and position. The LCD1510 had no pixel defects, but there were noticeable dark areas along the bottom edge and upper-right corner. On color ramps, dark shades dropped off to black more abruptly than they should. Also, the quality of scaled lower-resolution images was not as good as it should be. In its favor, the LCD1510 was one of the best monitors in the group when used in portrait mode.

The LCD1500M doesn't pivot, but it is priced more attractively than its sibling. Its automatic settings required some small adjustments to eliminate jitter. Color performance was smoother in the dark shades, making this panel better at displaying images with shadows. Text and video image quality were good.

While the pivot feature of the LCD1510 is appealing, the premium is steep; lower-priced pivoters from IBM, MAG Innovision, and ViewSonic performed better overall and cost hundreds less. The LCD1500M has a more appealing price, but it still isn't a dominant competitor.—*Alfred Poor*

Nokia 500Xa

\$1,520 street. Sausalito, CA; 415-331-4244; www.nokia.com.

● When you consider the source and the price, the Nokia 500Xa is a bit of a disappointment. Though it comes with a detachable active USB hub and integrated business audio, other competitors offer better value.

In our labs, setting up the display required extensive adjustment of the tune control to eliminate flutter.

Color ramp tests revealed remarkably smooth, precise color control, and colors overall were brilliant and clear. The brightness and contrast controls were poorly linked, however; to make black shades truly black, we had to turn the brightness so far down that white shades were drained of their brilliance. Blocks of gray background showed noticeable pixel jitter, and we saw startling interlace flicker on some test patterns. Because of a ghosting problem, many color combinations and fine details had blurry borders, as did standard black-on-white text. Our motion video clip was also a bit blurry.—*JL*

Number Nine DFP/SGI 1600SW

\$2,500. Mountain View, CA; 888-744-7373; www.sgi.com/go/flatpanel.

● The Number Nine DFP (Digital Solution Pak; also sold as the 1600SW from Silicon Graphics) has a wide 16:9 aspect ratio, native 1,600-by-1,024 resolution, and an LVDS digital interface unlike any other monitor in the group. Its wide-format screen makes it ideal for workstation users (CAD, modeling, and the like), though overall image quality trailed that of some other digital models.

The panel comes with the fine Number Nine Revolution IV graphics accel-

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	CRT Monitor Model/ Viewable Area	TCO	Dot Pitch/ CRT Type	Max. Horizontal Scan Rate	Max. Resolution	Est. Street Price
21"	VisionMaster Pro 502 (19.5" VHS)	TCO '95	0.28mm/AG	110khz	1600 x 1440 @ 75hz	\$399
	VisionMaster Pro 501 (19.5" VHS)	TCO '95	0.28mm/AG	110khz	1600 x 1200 @ 75hz	\$339
	VisionMaster 502 (19.5" VHS)	TCO '95	0.27mm/dp	110khz	1600 x 1440 @ 75hz	\$399
18"	VisionMaster Pro 450 (18.0" VHS)	TCO '95	0.25mm/AG	115khz	1600 x 1440 @ 80hz	\$699
	VisionMaster 450 (18.0" VHS)	TCO '95	0.26mm/dp	102khz	1600 x 1200 @ 80hz	\$599
17"	VisionMaster Pro 400 (16.0" VHS)	TCO '95	0.25mm/AG	96khz	1600 x 1200 @ 75hz	\$469
	VisionMaster 400 (16.0" VHS)	TCO '95	0.26mm/dp	96khz	1600 x 1200 @ 75hz	\$409
	3702BT (16.0" VHS)	TCO '95	0.28mm/dp	96khz	1280 x 1024 @ 85hz	\$369
15"	VisionMaster 350 (13.7" VHS)	MPR-II	0.28mm/dp	69khz	1280 x 1024 @ 65hz	\$209

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January 6, 1998
VisionMaster Pro 17



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VisionMaster Pro 21



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April 1997, May 1997, June 1997
VisionMaster Pro 21



October 7, 1997
VisionMaster Pro 17
October 6, 1998
VisionMaster 450



September 1998
VisionMaster Pro 500



Twelve Time Winner
July 1996, Jan 1997, March 1997, July 1997,
Sept 1997, Jan 1998, March 1998,
May 1998, July 1998, Sept 1998
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SUMMARY OF FEATURES

LCD Monitors

	AcerView F51	ADI MicroScan 6L	Advan AGM15T	Argon TP15	Compaq TFT5000	Dell 1500FP	EIZO-Nano FlexScan L360	Hitachi SuperScan LC150
Street price (except as indicated)	\$1,000	\$940	\$1,000	\$950	\$1,200	\$1,000 direct	\$1,240	\$1,350
Viewable screen size (diagonal, in inches)	15.0	15.0	15.0	15.0	15.1	15.0	15.0	15.0
Interface	Analog	Analog	Analog	Analog	Analog	Analog	Analog	Analog
Pivot feature	☐	☐	☐	☐	☒	☐	☐	☐
LCD panel manufacturer	Fujitsu	Samsung	Sharp	Sharp	Info not available	Sharp	Sharp	Info not available
Native resolution	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Supports lower resolutions	☒	☒	☒	☒	☒	☒	☒	☒
Macintosh-compatible	☐	☒	☒	☒	☒	☒	☒	☒
Complies with TCO 95	☒	☒	☒	☒	☒	☒	☒	☒
Built-in USB hub	☐	\$79	\$95	☐	☐	\$50	☒	☐
Mounting plate for arm/wall mount	☐	☒	\$100	☐	☒	\$50	☐	☐
Anti-theft lock slot	☐	☐	☐	☐	☒	☒	☒	☐
Protective screen available	☐	☐	☐	☐	☒	☐	☐	☐
Built-in speakers	☐	☐	☐	☒	☐	☐	\$85	☐
Standard warranty on parts/labor	3 years/3 years	4 years*/4 years	3 years/3 years	3 years*/3 years	3 years*/3 years	1 year/1 year (with system, 3 years)	3 years/3 years	3 years*/3 years
Quick-exchange program under warranty	☐	☐	☐	☒	☒	☒	☒	Optional
Toll-free technical support	☒	☒	☒	☒	☒	☒	☒	☒
Technical-support hours (eastern time)	24 hours, 7 days	24 hours, 7 days	10:00-10:00 M-F	10:00-8:00 M-F	24 hours, 7 days	24 hours, 7 days	11:30-8:00 M-F	8:30-8:00 M-F

	Nokia 500Xa	Number Nine DFF/ SGI 1600SW	Optquest L700	Panasonic PanaFlat LC50S	Princeton DPP560	Proview PT-500	Samsung SyncMaster 530TFT	Sanyo LMU-TF150A1
Street price	\$1,520	\$2,500	\$980	\$1,000	\$1,000	\$850	\$1,090	\$1,300
Viewable screen size (diagonal, in inches)	15.0	17.3	15.1	15.0	15.0	15.0	15.0	15.0
Interface	Analog	Digital	Analog	Analog	Digital	Analog	Analog	Analog
Pivot feature	☐	☐	☐	☐	☒	☐	☐	☐
LCD panel manufacturer	Philips	SGI	LG Electronics	Matsushita	Info not available	Samsung	Samsung	Sanyo
Native resolution	1,024 x 768	1,600 x 1,024	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
Supports lower resolutions	☒	☒	☒	☒	☒	☒	☒	☒
Macintosh-compatible	☒	☒	☒	☒	☒	☒	☒	☒
Complies with TCO 95	☒	☒	☒	☐	☒	☒	☒	☒
Built-in USB hub	\$69	☒	☐	☒	☐	☐	☐	☐
Mounting plate for arm/wall mount	☒	☐	☒	☒	☐	☐	☒	☒
Anti-theft lock slot	☒	☐	☐	☐	☒	☐	☐	☐
Protective screen available	☐	☒	☐	☒	☐	☐	☒	☐
Built-in speakers	☒	☐	☐	☒	☐	☒	☒	☐
Standard warranty on parts/labor	3 years*/3 years	3 years* (graphics card, 5 years)/3 years	3 years*/3 years	3 years/3 years	3 years/3 years	2 years*/1 year	3 years*/3 years	15 months/ 15 months
Quick-exchange program under warranty	Optional	☒	☒	☒	☒	☐	Optional	☐
Toll-free technical support	☒	☒	☒	☒	☒	☒	☒	☐
Technical-support hours (eastern time)	8:00-8:00 M-F	8:30-6:00 M-Th, 8:30-5:00 F	10:00-9:00 M-F	24 hours, 7 days	24 hours, 7 days	11:00-8:00 M-F	24 hours, 7 days	11:30-8:00 M-F

* Backlight, 1 year

erator. In our labs, the monitor delivered a sharp, jitter-free image. But the monitor was weak on dark and light shades, and there was noticeable ghosting on some high-contrast screens. If you need the wide screen, it's the only LCD game in town. For the price, we would have preferred perfect image quality all around.—AP

Optquest L700

\$980 street. Walnut, CA; 800-843-6784; www.optquest.com.

● The Optquest L700 is one of the better analog LCD monitors we saw, and one of the most affordable. It's certainly worth a look if you want to trade up to LCD.

The L700 displayed more saturated colors than most LCDs we tested, and a

greater ability than most to distinguish between different levels of brightness. Full-motion video was not as smooth as it could have been, but was better than with many LCDs. And the measured viewing angles and 242:1 contrast ratio were adequate. You won't find such extras as USB connectors or the ability to pivot in this monitor, but you will find a high-quality

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IBM T55D	Iiyama Pro Lite 38B	KDS VS-F15	LG Electronics 500LC	MAG Innovation LT541C	NEC MultiSync LCD1500M	NEC MultiSync LCD1510
\$950	\$1,130	\$900	\$1,000	\$850	\$1,000	\$1,600
15.0	15.0	15.0	15.1	15.0	15.0	15.0
Digital	Analog	Analog	Analog	Analog	Analog	Analog
■	□	□	□	■	□	■
Samsung	NEC	Samsung	LG Electronics	Toshiba	Matsushita	NEC
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
■	■	■	■	■	■	■
■	■	■	■	■	■	■
■	■	■	■	■	■	■
\$49	■	□	□	■	■	□
■	\$200	□	□	■	■	■
■	□	□	□	□	■	■
□	■	□	□	□	■ integrated)	■ integrated)
□	■	□	□	□	■	□
3 years/3 years	3 years*/3 years	3 years*/2 years	3 years*/3 years	3 years/3 years	3 years/3 years	3 years/3 years
■	Optional	■	□	■	■	■
■	■	■	■	■	■	■
8:30-8:00 M-F	8:30-5:00 M-F	10:00-8:30 M-F	24 hours, 7 days	10:00-8:00 M-F	8:30-8:00 M-F	8:30-8:00 M-F

Sceptre BT15+	Sceptre BT15D+	Sony CPD-L150	Toshiba TekBright 50D	ViewSonic VPA150	ViewSonic VPD150
\$1,000	\$1,100	\$1,400	\$1,300	\$950	\$1,000
15.0	15.0	15.0	15.0	15.0	15.0
Analog	Digital	Analog	Digital	Analog	Digital
□	□	■	■	■	■
Fujitsu	Fujitsu	Info not available	Toshiba	Sharp	Sharp
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768
■	■	■	■	■	■
□	□	■	□	■	□
■	■	■	□	■	■
■	■	□	□	□	□
■	■	□	□	□	□
■	■	□	■	■	■
1 year/3 years	1 year/3 years	3 years/3 years	3 years	3 years	3 years
■	■	■ (for corporate accounts)	□	Optional	Optional
■	■	■	■	■	■
11:30-8:30 M-F	11:30-8:30 M-F	7:00-10:00 M-F 10:00-6:00 Sat	24 hours, 7 days	10:00-9:00 M-F	10:00-9:00 M-F

image that's suitable for long sessions.
—MDS

Panasonic PanaFlat LC50S

\$1,000 street. Secaucus, NJ; 800-742-8086; www.panasonic.com/alive.

● The Panasonic PanaFlat LC50S is an analog monitor loaded with extras usually not found at this price, including inte-

grated speakers and microphone (with headphone and microphone jacks) and a USB hub with one upstream and four downstream ports. Its image quality is acceptable but not outstanding.

In subjective evaluation, the LC50S proved to be a consistent performer—after we corrected some noticeable jitter using the horizontal fine-tuning control.

Darker shades of color were somewhat difficult to differentiate, making this monitor less suitable for high-end graphics applications. Still, if you want the extras at an attractive price, it might be worth a look—though be sure to cross-shop the unit from MAG Innovation.—BB

Princeton DPP560

\$1,000 street with digital interface card, \$900 without. Santa Ana, CA; 800-747-6249, 714-751-8405; www.pgr.com.

● Equipped with USB ports and a screen that pivots between portrait and landscape orientations, the Princeton DPP560 is one of the more affordable digital-interface monitors available.

Princeton offers a choice of ATI digital interface cards you can order through the company, or you can opt to supply your own. Image stability on our tests was outstanding, with no pixel jitter. Text and fine detail were sharp and clear. But we found white levels oversaturated, with no way to distinguish faint shades of gray from pure white. This lent a pinkish tone to reds and produced a washed-out effect in our video clip. In addition, black shades weren't fully black. These problems may not bother the typical business user, however, and the price and features certainly make the DPP560 worth a look.—JL

Proview PT-500

\$850 street. City of Industry, CA; 800-776-8439, 626-581-1007; www.proview.net.

● Targeted at users who want an LCD multimedia monitor on a budget, the Proview PT-500 features a pair of 2-watt speakers. Unfortunately, its image quality is disappointing. Though the PT-500 made an average showing on our brightness, color, and contrast tests, in subjective evaluation we found its image precision poor, with distracting moiré and pixel jitter that couldn't be adjusted with the user controls. In text screens, we saw major ghosting problems; 7-point Arial text, acceptable on other units, was barely readable in the native 1,024-by-768 resolution. Overall, you're better off spending a little more on a model from Optique or Dell.—JL

Samsung SyncMaster 530TFT

\$1,090 street. Ridgefield Park, NJ; 800-933-4110; www.sosimple.com.

● The solid performance of the analog Samsung SyncMaster 530TFT makes it an

attractive candidate that should make your short list.

Setup is a bit more difficult than necessary, thanks in part to skimpy documentation. But the six-button front-panel controls are fairly easy to use, and the automatic settings needed only slight adjustments to reduce pixel jitter to a minimum. We did notice a slight glow along the bottom edge on black screens, but other-wise image quality was high across the board. The unit showed good differentiation between shades on the Display-Mate color ramps, and video-image quality was better than on most units we tested. A competitive product, the SyncMaster 530TFT is worth a look.—AP

Sanyo LMU-TF150A1

\$1,300 street. Chatsworth, CA; 818-998-7322; www.sanyolcd.com.

● The analog Sanyo LMU-TF150A1 does not perform as well as a lot of its competition, a disappointment considering its price.

Setup is straightforward, though using the on-screen menu system takes some practice. In our labs, the automatic adjust-

ment left the image off-center, and no amount of fiddling with clock and phase settings could get rid of all the pixel jitter. The panel was weak on both the darkest and lightest shades of gray, and we noticed ghosting on some images. The display has a fairly good viewing angle, though the image brightness drops off rapidly as you move off axis. Video images were only fair. All in all, models from Dell, LG Electronics, MAG Innovision, Optiquest, and others performed better and cost hundreds less.—AP

Sceptre BT15+, BT15D+

BT15+: \$1,000 street. BT15D+: \$1,000 with digital video card. City of Industry, CA; 800-788-2878; www.sceptre.com.

● This pair of LCD monitors from Sceptre Technologies delivers acceptable image quality, albeit with some flaws.

The most troublesome problem on the analog Sceptre BT15+ was obvious jitter, which showed up on almost every test screen with patterned fills. We couldn't get rid of it no matter how much we adjusted the monitor's settings. Other problems included overmapping of too many dark shades to black, which causes a loss of detail

in dark areas of a photo. The contrast ratio was relatively low—202:1. Other monitors, notably the Dell and Optiquest models, offer better image quality at a similar price.

The digital BT15D+ is bundled with the ATI Xpert card, which in past testing experience delivered very good 2-D graphics performance and passable 3-D. This monitor delivered better image quality than its analog sibling. It showed no jitter at all and did a better job of distinguishing between different shades—though it still showed weakness separating darker shades. And full-motion video was not as smooth as on other digital models. Here again, you can find other monitors (notably the digital offering from IBM) that offer better image quality.—MDS

Sony CPD-L150

\$1,400 street. San Jose, CA; 800-352-7669; www.sony.com/displays.

● The analog Sony CPD-L150 offers high image quality and the ability to pivot between landscape and portrait modes. It's a fine monitor, but no bargain in this time of sub-\$1,000 LCD monitors.



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HARDWARE

LCD Monitors

The CPD-L150 did a fine job of distinguishing between different intensities across the entire scale of brightness. On full-motion video, the CPD-L150 did better than most of the competition, with reasonably smooth motion. Its contrast ratio and viewing angles were average for the group. One nice touch is an Auto button that automatically adjusts size and position, though afterward, we still had to go through the menus to fine-tune the image. The CPD-L150 offers a fine image, but be sure to check less expensive pivot offerings from MAG Innovision and ViewSonic, which we liked almost as much.—MDS

Toshiba TekBright 50D

\$1,300 street, including digital interface card. Irvine, CA; 800-867-4422; www.toshiba.com.

● The digital interface Toshiba TekBright 50D is one of the best monitors in this roundup, though some flaws (and a relatively steep price) mean you'll want to check the competitors from IBM and Optquest.

The TekBright comes bundled with a graphics adapter based on the S3

Virge/MX+ chip. In our experience, this aging chip delivers adequate 2-D acceleration but poor 3-D, so gamers will want to pass. Like the digital entries from IBM and ViewSonic, the Toshiba's screen pivots between landscape and portrait modes.

Thanks to the digital interface, images are crisp and rock-steady. The monitor had excellent uniformity, and almost no ghosting in high-contrast images. The display is a bit weak, however, in the darkest and lightest color shades, and there's no adjustment available to improve the image. The only other weak point is that scaled images from lower resolutions could be much better—but you also have the option of not scaling them. The TekBright is worth a look, but check out the others before you commit.—AP

ViewSonic VPA150, VPD150

VPA150: \$950 street. VPD150: \$1,000 with digital graphics card, \$940 without. Walnut, CA; 800-888-8583; www.viewsonic.com.

● The ViewSonic VPA150 and VPD150 have built-in speakers and the ability to pivot between landscape and portrait

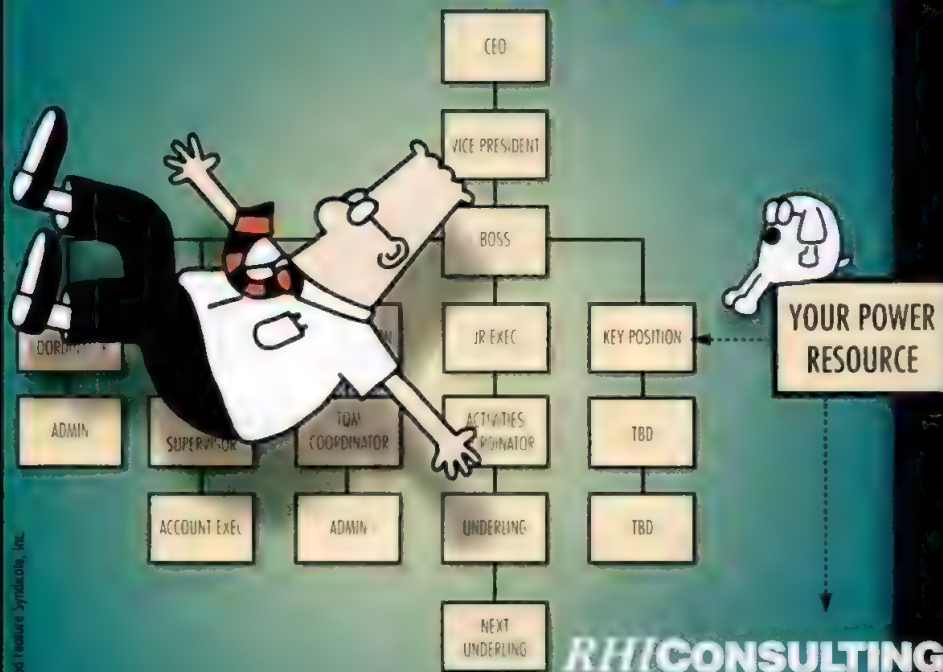
modes. Both units are attractively priced and are reasonable choices for the features they deliver.

The analog VPA150 offers more saturated colors than many LCDs, one of the better contrast ratios (340:1), and more than acceptable measured viewing angles. We saw only minor problems in Display-Mate testing. However, the monitor offers only 18-bit color—about 260,000 colors—a limitation that will be noticeable in photos and color-intensive applications.

ViewSonic offers the digital VPD150 with the ATI Xpert graphics card, which should deliver good 2-D performance for business apps and passable 3-D game acceleration. Like its analog sibling, it delivers saturated colors and a good contrast ratio. But here again, ViewSonic was not able to differentiate color shades as well as other models. And video was not as smooth as on others.

The speakers, pivot capability, and price make these monitors contenders. If you run standard business applications and don't mind limited color range, these ViewSonic models are worth a look.—MDS PC

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enterprise Servers

By Alan Zeichick

The new generation of Intel Xeon-based enterprise servers is reaching for the sky. With 2MB of L2 cache, four-way multiprocessing, and high-availability features, they come close.

With the advent of the latest Intel Pentium II Xeon processor, the Windows and Intel juggernaut has taken another step deeper into the enterprise. Today's Intel-based servers, harnessed to Windows NT 4.0, have tremendous horsepower and the capability to handle a wide range of applications, such as messaging, enterprise resource planning (ERP), online transaction processing (OLTP), data modeling, active Web page delivery, and other computation- and I/O-intensive tasks.

Or you could use one of these systems to consolidate smaller servers handling lighter loads, such as file-and-print or Web hosting, into one machine.

These machines have honestly earned the designation *enterprise servers*, as our Editors' Choice winner, the \$62,990 IBM Netfinity 7000 M10 shows. Its performance is excellent,

Fibre Channel is often present between an external storage box and the main server, but none of the vendors in this roundup chose to use this technology in their storage solutions.

■ These servers, each boasting four 450-MHz Pentium II Xeon chips with 2MB of L2 cache, are powerful. Eight-way servers are right around the corner, and more powerful CPUs—Intel's new Pentium III Xeon chips with Streaming SIMD Extensions—are now available.

■ Hot-plug PCI, which lets you replace cards on the fly, is a reality. All the servers in this roundup are ready for it, and three of them offer the capability now. Broad hot-add capability is almost here.

Compaq Computer Corp	147	Hewlett-Packard Co	152	IBM Corp	156
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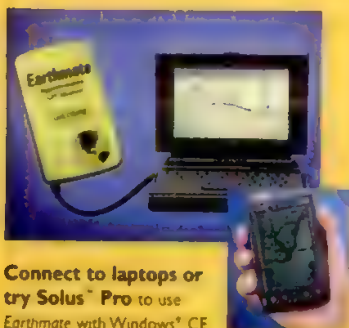
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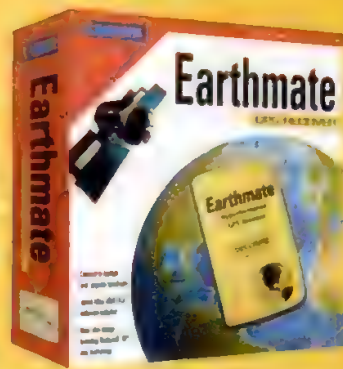
DeLorme's GPS Receiver Gets Rave Reviews!

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New Releases!

Editors' Choice

• IBM Netfinity 7000 M10



Good enterprise servers start with top performance and go from there. Our Editors' Choice-winning IBM

Netfinity 7000 M10 (\$62,990 street) is a perfect example, offering terrific scalability, serviceability, and high-availability features, as well as strong management—all on top of good performance.

Most components are easily accessible from the front of the Netfinity, and the remaining components can be accessed after the simple removal of the unit's top panel. You can add up to

8GB of RAM and benefit from IBM's Chip-kill DRAM technology, which adds a layer of fault tolerance to standard ECC memory. The unit also comes with fully functional hot-plug PCI slots (you can hot-add *now*) and includes IBM's built-in remote Advanced System Management PCI adapter for controlling the server via a LAN or dial-in connection. IBM also offers its Light-path technology to guide you directly to failed parts. To help you set up, IBM provides two complete and fairly easy-to-use tools: its ServerGuide and the IBM Netfinity Manager, which is Web-enabled.

The Compaq ProLiant 6500 (\$74,420 street) earns an honorable mention. This well-designed server comes with everything you need in the enterprise, and like the IBM unit, it also has functional hot-replace PCI slots. Compaq's Insight Manager is very complete and easy to use, and again like the IBM unit, the ProLiant is now Web-enabled.

as are its high-availability and expandability features. The unit also boasts hot-plug and hot-add PCI capabilities *now*; most other units are ready for them but waiting for Windows 2000 to provide the drivers. We were particularly impressed with IBM's unique Light-path technology, which guides you to failed components. That, plus the fact that it's easy to disassemble and reassemble, makes the server very easy to service.

None of this is to imply that Unix is dead or that mainframes are obsolete. A Windows-based server still has work to do before it can be an affordable one-for-one replacement for a Sun Starfire, HP 3000, or IBM 370. The hardware needs to continue scaling to better performance, and Windows must become more stable and reliable. But there's no doubt that many tasks formerly requiring the power and legendary characteristics of Unix or mainframe systems can now be done with Intel and Microsoft technologies. Also, though the tested servers were designed for Windows NT, they can run alternate operating systems such as NetWare, SCO Unix, Linux, and more.

REVIEW CRITERIA

Each server had to be configured with four Pentium II Xeon/450 CPUs with 2MB L2 cache—the fastest Intel CPU available at the time of testing. Servers had to come with 2GB of RAM, and with at least 180GB of storage configured in RAID 5 and divided into no more than ten hard disks, and they had to run on Windows NT 4.0 (on a separate disk). We also asked for four 100-Mbps Ethernet ports per unit, which is required for our ServerBench tests to stress the systems.

We asked each vendor to preinstall its management software and suggested that the vendors provide redundant and fault-tolerant systems, configured for standard racks. We did not specify a price range.

We received units from Compaq, Dell, HP, Hitachi, and IBM. Toshiba and Unisys were unable to send systems to us in time for our roundup. Data General and SAG declined to participate.

PERFORMANCE AND BEYOND

In many ways, the servers we tested are very similar, using identical Intel CPUs and chip sets. It's not surprising then that most units here had similar performance. The Hitachi was the exception, because it had problems with its disk subsystem, which delayed data caching and hampered its performance. Hitachi expects the problem to be solved by the time you read this. Excluding the Hitachi, peak throughput for the other servers varied by less than 8 percent between highest and lowest scores. The IBM and HP units had higher sustained throughput than the rest, because their disk controllers were set to use a write-back cache

policy, a fairly specialized setting. Configure your disk controller according to the application you use most.

But good performance is merely the starting point for enterprise servers. A well-rounded server must be reliable, serviceable, manageable, and scalable, too. We examine the systems in each of these respects (and more) and present detailed results in PC Magazine Labs' Scorecard.

Hardware reliability is difficult to measure but can be improved with redundant and high-availability features. An enterprise server should have three or more hot-plug power supplies and should run fully loaded on two supplies. Each power supply should have its own cord, which could be connected to uninterruptible power supplies. Fans, too, should be redundant. All hard disks should be hot-pluggable; the RAID controller would take care of redundancy. Surprisingly, some vendors didn't make the grade.

At the top of the class is the IBM unit,



www.pcmag.com/hotlinks

Please join us online for additional information on our benchmark tests.

► ZD Net Products: Networking Products

www.zdnet.com/products/networkmanager/server.html

The latest reviews, tips, and solutions dealing with servers and networking, from all of the Ziff-Davis publications.

► Intel Corp.'s Pentium III Xeon

<http://www.channel.intel.com/pressroom/archive/releases/dp011199.htm>

Information on Intel's new Pentium III Xeon processor, introduced on March 17, 1999.

► Microsoft Corp.'s Windows 2000 Server Family

<http://www.microsoft.com/windows/server/PRID-215>

Information on the forthcoming product, current beta versions, and tips to help manage the transition.



The servers from Compaq, Dell, and IBM (our Editors' choice) all earned *excellent setup* ratings, reflecting the inclusion of setup CDs with clear instructions, intuitive interfaces, and configuration help that covers the main server and external arrays. Although HP provided a setup CD, the disk lacked clear instructions

and gave little troubleshooting help. Hitachi's setup programs were housed in a three-disk set that was not as easy to use as the CDs provided by other vendors and had less detailed information.

Compaq and HP offered the most complete and easy-to-use *management* solutions. Both have Web-based management suites that deal with every aspect of server management. Dell and IBM also had good packages, although Dell's is not currently Web-compatible and IBM's interface is not as intuitive as others.

IBM's server stood out in the *availability* category. The unit had redundant power supplies with individual power cords and redundant disk controllers and fail-over NICs, as well as individually removable fans. The company went one step further with its Chip-kill DRAM, which tracks and corrects memory errors not covered

by typical ECC memory. Dell's unit lacked individual power cords for the power supplies in its main chassis, and its fans were not individually removable. The Hitachi system stumbled, because both its fans and power supplies are difficult to remove (they're screwed in).

Most systems did well on our *scalability* rating. Each can have at least 4GB of RAM, with the HP, Hitachi, and IBM units expandable to 8GB. Each also has a reasonable number of PCI slots. Because it is a pedestal system, the Hitachi unit is the most expandable, offering lots of drive bays and PCI slots.

Compaq and IBM earned top marks for *serviceability*. The Compaq's design was the best, although both units are very easy to get into and offer access to all parts without tools. IBM also has its Light-path technology, which leads you quickly to a faulty part, facilitating repairs. The HP and Hitachi units faltered, because neither has tool-free access to the case interior and most parts.

We looked at a variety of service terms for the *service offerings* category—length of on-site service, standard response times, software support, worldwide service, included remote management and diagnostics, and more. Compaq, HP, and IBM had the most complete offerings, with Dell and Hitachi following closely.

	Setup	Management	Availability	Scalability	Serviceability	Service offerings
Compaq ProLiant 6500	Excellent	Excellent	Good	Good	Excellent	Excellent
Dell PowerEdge 6350	Excellent	Good	Fair	Fair	Good	Good
HP NetServer LXr 8000	Good	Excellent	Good	Good	Fair	Excellent
Hitachi VisionBase 8460	Fair	Fair	Fair	Excellent	Fair	Fair
Editors' choice IBM Netfinity 7000 M10	Excellent	Good	Excellent	Good	Excellent	Excellent

with three power supplies, multiple power cords, and many redundant fans. We were most disappointed with the Dell's single fan module and single power cord for its three power supplies.

Serviceability is a tricky issue. Many customers will choose to let the vendor or a local reseller perform maintenance. All vendors offer a variety of service options at varying prices. For those who will handle repairs and upgrades themselves—at least in part—the Compaq, Dell, and IBM servers proved easiest to work on, as all were accessible without tools. The HP NetServer 8000 was more difficult, because screws are used everywhere; the memory module, however, was easy to access and remove. The Hitachi unit also required screws for maintenance, but its size and some design features made many of its components easier to work on than the HP's components.

HP's Web-based TopTools was the best management software we saw, offering both a complete set of data and management tools and an intuitive interface. HP, like IBM, also bundles a remote-control solution with each system.

The HP, Hitachi, and IBM units were the most scalable. Whereas the Compaq and Dell go to 4GB, the HP, Hitachi, and IBM all handle up to 8GB of RAM—a comfortable ceiling, ready for RAM-hungry modern applications. These units also have plenty of slots: 12 for the IBM and 11 for each of the others.

THE NEXT ENTERPRISE SERVER?

The machines reviewed here represent the current state of the art. But the art is advancing quickly; Intel is on the verge of announcing its 500-MHz Pentium II Xeon, the Pentium III debuted in February, and a Pentium III Xeon, starting at 500 MHz, was released in March. Like the Pentium III, the Pentium III Xeon uses the Streaming SIMD (single instruction, multiple

data) Extensions; server applications are likely to be best served by the new memory-streaming instructions, which allow for directed caching of data, among other things.

Today's standard limit on four-way processing is also under fire. The Pentium II Xeon CPU supports eight-way processing, although Intel's 450NX chip set is limited to four-way. The HP and IBM units have already announced a proprietary eight-way upgrade for the servers reviewed here.

The rest are awaiting the release of the Profusion chip set for eight-way processing. Profusion was the brainchild of Corollary Systems; Intel acquired the company to get this technology last year. Compaq will be one of the first to release Profusion-based servers in the second half of this year; it helped develop Profusion. And don't forget Merced, the new 64-bit platform being jointly developed by HP and Intel, scheduled for release in 2000 or early 2001. A faster PCI bus, called PCI-X, is also on the way and will offer twice the performance of the standard PCI slots found in these servers. Look for this in the third quarter of 1999. Intel offers a competing standard, the Net Generation I/O (NGIO). Due out mid-2000, this new bus technology will, according to Intel, bring higher reliability as well as faster performance to your I/O.

Two hardware technologies you can take advantage of today are Fibre Channel and Intelligent Input/Output, or I2O. The Fibre Channel high-speed storage bus can be used to replace

Our Contributors: ALAN ZEICHICK is a principal technical analyst with Camden Associates. JEFFREY G. WITT is a technical director at PC Magazine Labs. TONY POMPILI is director of publishing and intranet systems development for Ziff-Davis. RUSS IWANCHUK was the project leader, and ANUSH YEGYAZARIAN was the associate editor in charge of this story.

SCSI in external drive arrays. This bus is already in use between the server and array by some vendors (though none in this roundup), and it's likely that within a year or two, many high-end storage solutions will use Fibre Channel. Simply by adding a Fibre Channel PCI adapter, you can upgrade at your leisure. I2O is also available, though only with a small number of products. Its claim to fame is that I/O interrupt handling is handled by special "interrupt processors," not by the system's CPUs.

Not all technologies will require new hardware. When it ships, Windows 2000 Advanced Server will feature built-in clustering (see "Clustering: To Do or Not to Do"), while Windows

2000 Datacenter Server will support up to 16-way multiprocessing and 64GB of memory, according to Microsoft.

DON'T WAIT AROUND

New technologies are coming down the pike. But then, they're *always* coming down the pike. What's exciting is that this latest generation of servers offers more capability for today's tasks than we've ever seen before. These units open up new performance possibilities for applications you may be running on Windows NT today, along with the potential to consolidate smaller servers onto a single platform.

Compaq ProLiant 6500

\$74,420 street. Houston; 800-345-1518, 281-370-0670;
www.compaq.com.

● Our first impression of the Compaq ProLiant 6500 was one of solid industrial design, and that impression remained throughout our testing. Priced at \$74,420 (street), the server is the most expensive here. It offers good performance, terrific serviceability and management, and plenty of internal space for drive expansion. You'll need to provide physical security yourself, however.

Disk scalability is one of the ProLiant's strengths. You can have up to 11 drives (including those for removable media) within the main chassis, and the matching 4-U-high Storage System UE can hold even more. The unit is one of the few to have functional hot-swap PCI slots (HP and IBM are the others); there are 6 of them, and all can hold 64-bit cards. But memory can be expanded only to 4GB, half that of some other reviewed units.

The ProLiant offers reasonable but not exceptional high-availability features. The hot-swap fans can be removed individually. The two hot-swap power supplies each have their own power cord and thus can be connected to different UPSs or even different electrical circuits. The matching Storage System UE has only a single power supply, thus lowering the fault tolerance of the entire solution.

Compaq's bootable SmartStart CD (Version 4.20B) provides very good GUI-based tools for setting up the server as well as the external storage array. SmartStart also runs diagnostics and updates the system's firmware. An option to save a configuration profile to floppy disk makes it easy either to restore the configuration after a motherboard swap or to replicate the configuration across identical servers. We wish,

however, that on-disk documentation had been provided on the CD as well, so that it could be accessed even if the server were off-line. For managing the server, Compaq has its Insight Manager, which collects inventory information on hardware and also enables version control of system drivers and utilities. The management software consists of a Windows console program and a software agent deployed to monitor over 1,000 different parameters. The software agent acts on device or software data and your predefined thresholds to create alarms via SNMP, pager, and e-mail. Also, Compaq has recently added HTTP support—so Insight Manager now works with Web browsers—and IP discovery capability for finding all enabled network devices. For remote management, Compaq offers the \$890 (street) Remote Insight Board, a PCI board with its own processor, memory, Ethernet interface, modem, and battery backup. The Remote Insight Board lets you work through the LAN or modem to perform any management function, including restarting your server even after a complete crash.

The four-button, four-line LED display is quite informative, with menu options to let the administrator view boot information and system status; it also shows faults and alerts. This was by far the most functional server display panel here. But a blinking alert LED would help administrators more quickly identify servers in need of immediate attention.

The ProLiant is of average height, using 7Us of rack space (12.3 inches). We liked the absence of flimsy removable plastic

bezels; this server has a simple metal front with convenient handles to slide the server out of the rack. Two thumbscrews hold the server to the rack. When you slide the unit forward, a single metal cover comes off to reveal the components, all of which are held securely in position. No tools are needed to remove PCI cards, processors, power supplies, any of the four fans, or the memory card.

The PCI slots, fans, and power supplies have indicator LEDs alerting you to problems, but they're not visible from the front of the rack. The PCI cards are protected from each other and the motherboard by plastic separators, and the motherboard can be removed easily.

The only physical security you'll find with the unit is whatever you provide yourself, as its power switch and internal components are readily available to all. —AZ

Dell PowerEdge 6350

\$51,120 direct. Round Rock, TX; 800-388-8542, 512-338-4400; www.dell.com.

● Priced at just \$51,120 (direct) and measuring only 4U in height, the Dell Power-



Dell's PowerEdge 6350 is nicely compact and easy to service, offering tool-free access.

BENCHMARK TESTS

Pentium II Xeon Servers



These four-way Pentium II Xeon servers are top performers, but similar hardware led to tight grouping on our tests. Optimizations in RAID controllers put the HP and IBM systems ahead of the pack. A 2MB L2 cache does make a difference.

You'll find any of these servers ready and able to do midrange computation-intensive enterprise duty, such as Web and application serving, database, messaging, and enterprise resource planning (ERP). This kind of computing used to be largely the domain of midrange RISC/Unix-based servers, but with this kind of muscle, Intel-based servers will continue to make their way into this space. This is as high-end as it gets for Intel, however, so don't look for these to take over the supercomputing world—yet. Server performance is important to your buying decision, but it shouldn't be the only thing you consider—high availability, good management tools, and an easy-to-service design are often more important.

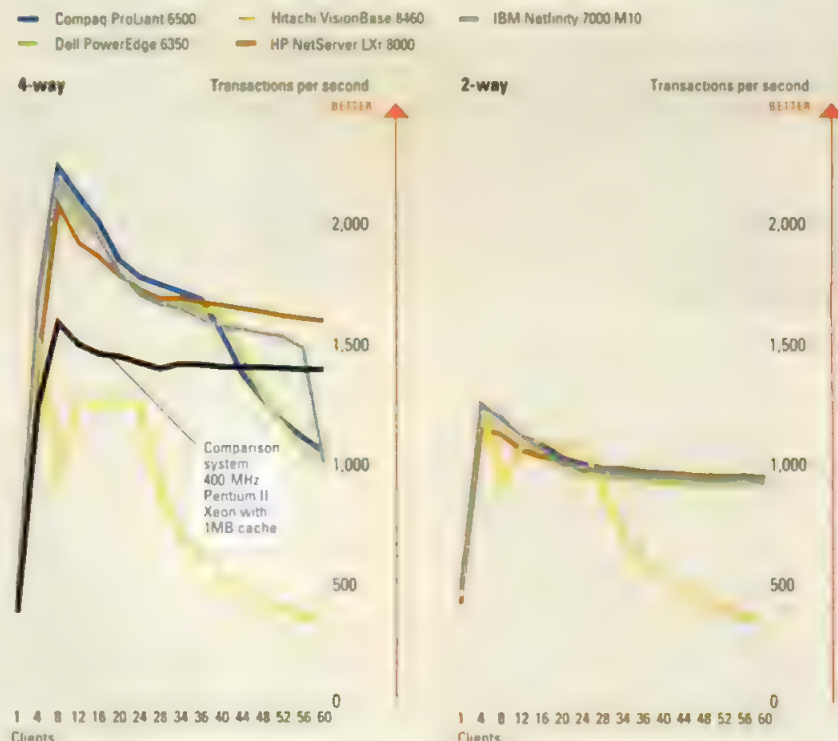
In general, all vendors took advantage of the technology, leading to similar ServerBench test performance from the servers in this roundup, with the exception of the Hitachi VisionBase 8460. There are two interesting parts of the performance curves to consider: the early peak of the curve and the tail. The Compaq ProLiant 6500 posted the highest peak scores—but not by much. Excluding the Hitachi, we saw only a 7 percent decrease in peak score from the ProLiant's high score to the HP NetServer 8000 LXr's result. The average peak score of the Compaq, Dell, HP, and IBM units was 36-percent better than that of our reference system, however—a noticeable difference resulting from faster processors. We used the same HP NetServer we tested for this roundup as a reference system, changing only its processors from four Pentium II Xeon/450 CPUs with 2MB of L2 cache to four Pentium II Xeon/400 CPUs with 1MB of L2 cache.

The Hitachi unit exhibited some unusual behavior on our tests. We know this server has the potential for good ServerBench test scores, but we were not able to see them with our standardized

test suite and test unit. ServerBench test mixes allow a certain amount of time for the server to cache data before the part of the mix that counts toward the score begins. The VisionBase's disk subsystem was operating slowly enough that it didn't fill its main memory cache, forcing the server to use data from disk during the test mix, which in turn resulted in poor ServerBench scores. In informal testing, we gave the VisionBase 8460

more than double the amount of caching time we gave the other servers and saw acceptable results (not shown here) for the non-disk-dependent part of the test suite. At press time, Hitachi claimed to have resolved the problem of slow disk performance, blaming a misconfigured RAID controller on our test unit. With parameters reset from the shipping default to a cache policy of write-through and an 8K stripe size, Hitachi expects its ServerBench test results to improve further, but we didn't have time to retest its server for this story.

At the tail end of the curves, disk subsystem configuration plays the major role in determining ServerBench scores. On our tests, the tail-end scores didn't distinguish themselves until the 36-client mark; after that, the Compaq and Dell units dropped away from the HP and the IBM, as they can



▲ **4-way** There was little difference in peak scores, excluding the Hitachi. The HP and IBM systems did best toward the tail end of the curve, where disk subsystems come heavily into play, thanks to RAID controllers set to use a write-back cache policy. The Hitachi suffered because of its disk subsystem.

▲ **2-way** Since the servers' performance was limited by the two processors on our tests, most of them posted nearly identical ServerBench test results. As on our four-way server tests, the Hitachi machine was the exception and scored poorly because of its problematic disk subsystem.

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BENCHMARK TESTS

no longer operate in system cache. HP's and IBM's RAID controllers were set to use a more aggressive write-back cache policy, where the RAID controller cache is used to delay writes to the physical disk. This results in lower disk overhead on our tests, which in turn postpones the need to go outside the cache for data. The IBM server's drop-off at 60 clients occurs when it finally has to go outside of cache, and we expect the HP unit's results to drop very soon after. Such a cache policy effectively speeds up disk performance in certain circumstances, such as when applications do a lot of sequential writes, but it isn't always the best choice. Compaq's and Dell's cache policies were set to give equal weight to read and write caching, which is a more general setting. A server's write policy should be tuned to the application it's running, and either of these settings can be right depending on circumstances.

We saw good scalability between two and four processors in these servers. Excluding the Hitachi, we saw an average of 78 percent improvement between two-processor and four-processor peaks.
—*Analysis written by Russ Iwanchuk*

How We Tested

Each server in this roundup had four 450-MHz Pentium II Xeon processors, 2GB of ECC DRAM, Intel's 450NX chip set, and an eight-disk hardware RAID 5 array, and was running Windows NT 4.0. Vendors installed the variation of Windows NT of their choice: Most units were installed with Service Pack 3, but the Hitachi used Windows NT's Enterprise Edition and HP used Service Pack 4.

We evaluated server performance using ServerBench 4.02, Ziff-Davis's synthetic benchmark program for testing application servers in a client/server environment. Our ServerBench tests use 1 to 60 clients to initiate test mixes on the server, designed to stress the server's various subsystems: disk, CPU/memory, and network. During a ServerBench test run, a client machine attached to the server sends it a transaction—a request for the server to perform a processor-, disk-, or network-related task. Each test run consists of several iterations of the stress test, each time with an increasing number of clients, and thus, an increasing load on the server. Clients report back how long they waited for the server to complete

their transactions, generating a result in transactions per second (TPS). We report scores for each server at both four- and two-processor configurations. When testing a server at two CPUs, rather than physically removing the CPUs, we used the "numproc=2" switch at Windows NT's boot time.

We used the new enterprise test suite (sys_60_ent.tst) to test the servers' performance as enterprise-level application servers. The enterprise test suite differs from the formerly used test suite in the amount of data space allocated for each client: 32MB instead of 16MB. By using more data per client, the server is forced to rely on its disk subsystem to serve data sooner, since its system cache fills more quickly.

These ServerBench test runs consisted of 16 mix iterations. Mixes began with one client, then four, then eight, and on up to 60 clients. Our client test-bed consisted of 60 Windows 95 PCs: 32 Pentium Pro/200-based Dell Dimension XPS Pro200ns, 16 Pentium/166-based Dell Dimension XPS P166s, and 12 Pentium Pro/233-based Dell OptiPlex GXas. Each had 32MB of RAM.

We followed the default configuration for enterprise servers as specified by ZD Benchmark Operations (ZDBOp), except for the configuration of the disks. ZDBOp recommends disabling write-back caching on the RAID controller, but we tested with RAID controller settings as submitted by the vendor which, in most cases, were set to write-back caching enabled. Also, each server used eight disks for data rather than the recommended nine. Results from servers with slightly varying numbers of data disks should still be comparable, however, since we have found in the past that changing the number of member disks in an array by only a few disks doesn't affect performance very much.

To eliminate the network as a potential bottleneck to server performance, we tested each server with four NICs of the vendor's choice. Clients were arranged into four identical 15-node subnets, attached over 100-Mbps Ethernet to each NIC. We used two Extreme Networks Summit 48 10/100 switches, configured into four virtual LANs, to connect the clients, server NICs, and ServerBench controller machine. We used Windows NT's TCP/IP stack for the networking protocol.

Edge 6350 offers you an inexpensive way to get a lot of horsepower. The unit, an average performer, is fairly easy to manage locally or remotely and has some good physical security. The saying "You get what you pay for" is true, however. The unit doesn't provide the same design quality and many scalability and high-availability features we would expect to find in an enterprise server.

The PowerEdge packs a lot into a compact space. A small door, protected by a key lock, swings open to unveil the power switch, the floppy disk and CD-ROM drives, and three 1-inch drive bays. The unit offers seven hot-plug-ready PCI slots (four 64-bit, three 32-bit)—average for this roundup. It came with the 3U-high external PowerVault 200S storage chassis, which is also equipped with a key lock to protect its eight drive bays. Memory, however, can be expanded only to 4GB; most other tested systems offered twice that.

The PowerEdge was easy to service without tools, though we didn't always like what we saw inside. The server is secured in a standard rack via four thumbscrews; the three power supplies are located near the front of the PC and can be unlocked and removed on the fly. The fans are directly behind the power supplies and can also be grabbed and pulled. All three fans are in the same plastic housing, so pulling out that housing removes all cooling. A big warning sticker states that the machine can survive for up to 2 minutes with the fans removed; be sure to keep a spare very handy. (All other servers in this roundup have individually removable fans.)

A big piano-hinged cover, secured by another key lock, provides access to the CPUs, memory card, and expansion slots. The cards are held in place by plastic latches; ours refused to lock properly. The plug-in memory board doesn't even have that much protection, and it flopped around alarmingly whenever the top cover was open; even when the cover was closed, the board had freedom to move. There are no plastic spacers between the PCI cards, and no protection beneath the slots. The motherboard is easy to remove, though.

The PowerEdge's three power supplies provide ample redundancy, but its single power cord has a single point of failure. Dell's 200S external storage cabinet, however, offers two power supplies,

each with its own power cord. The unit's front-panel display is not very informative. Pulling a hard disk out of the RAID array or yanking the fans caused one small LED to blink on the front panel.

As for software, the PowerEdge comes with Dell OpenManage Server Assistant 4.0, a bootable Windows 95 CD including GUI-based system setup and configuration utilities, remote-management software, online documentation for several PowerEdge models, and tools to build driver and utility floppy disks. The software was adequate and intuitive to use.

For a broader management scheme, Dell has turned to Hewlett-Packard for two additions: the HP OpenView Network Node Manager (NNM) Special Edition (SE) and HP OpenView ManageX/SE. NNM/SE's monitoring goes beyond internal server components and network features to LAN topology information and event management. OpenView ManageX/SE (also included with the HP NetServer LXr 8000) implements NOS administration and sets policies for tuning specific applications. Dell has created several policies specific to its server and available on its Web site.

To manage the system remotely, you can purchase the optional \$649 Dell Remote Assistant Card 2 (DRAC2), which lets you take complete remote control of the system, through either the on-board Ethernet adapter or the modem. Unlike HP's and IBM's similar products, Dell's can't yet be used with a Web browser. Dell claims integration with management packages such as CA Unicenter, Microsoft SMS, Tivoli, and more.—AZ

HP NetServer LXr 8000

\$61,260 street. Palo Alto, CA; 800-322-4772, 415-857-1501; www.hp.com.

● The HP NetServer LXr 8000 (\$61,260 street) has some terrific features but falters in terms of serviceability and physical security. It did very well on our performance tests, with consistently high throughput, and held out the promise of an eight-processor upgrade. Its Web-based management is the best we saw, and it was one of the most physically rugged servers we tested, making it a good enterprise choice.

The server is sturdily built but, unlike most other tested servers, lacks tool-free access. Lots of Torx screws secure the

server to the rack and fasten the metal cover. There's no real handle to help slide the server out of the rack; we just had to grab and heave. Don't grab and heave on the cheap plastic LCD panel; it'll snap off.

More Torx screws hold the PCI cards in place, making them a nuisance to change. They create the ever-present danger that you might drop a screw inside, as we did. That's poor design, especially since the PCI slots are hot-swappable. Where do you find thumbscrews? Latching down the processors. The six fans don't have screws, but to pull them out, you have to stick your fingers inside the metal frames—a process that gave everyone concern. Torx screws also hold down the motherboard, but other than that, it's easy to remove and replace. The memory trays—tool-free and front-accessible—are very easy to remove.

There are four 64-bit PCI slots, six 32-bit PCI slots, and a 16-bit ISA slot. The 64-bit slots are protected by side and bottom plastic protectors, but the 32-bit slots aren't. Internal storage space is sparse, but this server was designed for use with external storage. The 3U NetServer Rack Storage/12 box holds up to 12 drives.

The NetServer has three power supplies—which can be removed individually by lowering a single lever—but only a single power cord, creating a single point of failure. This server, alone of those we tested, requires 220/240 volts, so make sure you're equipped to provide that much power. The external storage box has two 120/240-volt power supplies, each with its own power cord. Don't look for physical security: There is none to restrict access to the power switch or internal components. Six fans provide redundant cooling, and an automatic-restart feature reboots the server if Windows NT hangs. The bootable NetServer Navigator CD includes basic GUI utilities to inventory system hardware, configure the disk array, create driver floppy disks, manage the hard disk's utility partition, or update the system BIOS. The software is functional but in no way leads administrators through the configuration process. There's also no documentation on the bootable CD to

help in tracking down configuration problems. The machine does include a two-line LCD panel, with a cursor button to monitor for alerts or see what's happening at boot time, and has an "alert" LED to notify operators of pending messages.

HP TopTools management is the best we saw. The vendor takes a two-pronged approach, with its HP TopTools for Servers and HP OpenView ManageX/SE. TopTools generates alerts and lets you monitor, configure, and troubleshoot the server—all with a Web browser—locally and remotely. You can monitor subsystem features and functions and browse SNMP, DMI, and WBEM-specific information.

Alerts inform you of performance interruptions and impending failures; they can also be directed to larger-scale management platforms such as OpenView. Extending TopTools' reach is HP's TopTools Remote Control Card (bundled with each system), which lets you access the server via LAN or dial-up even if the system is down. The card provides rebooting capabilities, remote system control, and access to all of TopTools' management features. OpenView ManageX/SE (also included with the Dell server) completes the package, implementing NOS administration and setting policies for tuning specific applications such as Microsoft Exchange.

HP and IBM are the only vendors in



HP's NetServer's great management features are counterbalanced by problems with serviceability.

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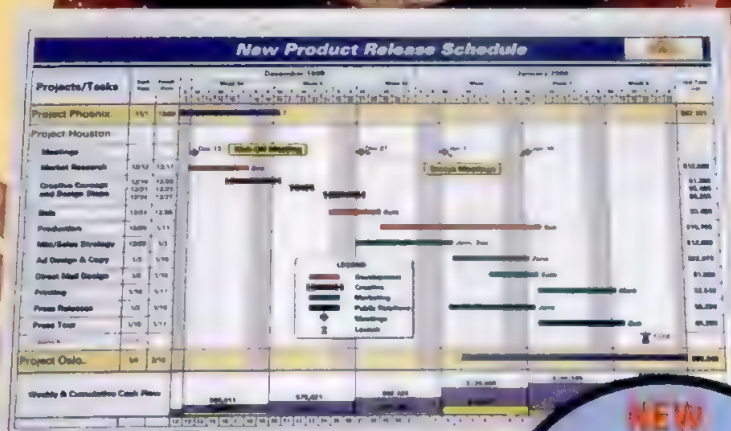
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clustering: to do or not to do

PC servers have always been perceived—and rightly—as less stable than the big iron boxes. Glass-house proponents turned up their noses at such upstarts, especially when choosing the server platform for OLTP and other mission-critical applications.

Clustering software is giving PC server enthusiasts more leverage to sell PC servers—with operating systems such as Windows NT Server—as a more reliable platform. And most vendors, including the group whose products we reviewed, offer their servers as part of a clustered solution. You can easily and inexpensively add a second server as a hot standby to your primary server, although the applications you run do have to be tuned or modified for clustering. With the application properly set, you can use products such as Compaq's Digital Clusters for Windows NT and Microsoft Cluster Service (MSCS) to build a higher-availability environment using PC operating systems.

In the past, PC server manufacturers relied solely on hardware and monitoring solutions to keep PC servers up.

Servers were built with as much redundancy as was practical and economical, including mirrored drives, RAID drives, redundant SCSI controllers, dual power supplies, and monitoring. But most PC redundancy and higher-reliability hardware hasn't addressed the issue of the OS and applications.

Today's clustering is aimed at improving the reliability of machines, NOSs, and sometimes the applications that run on them. Products like MSCS provide automatic fail-over of the network OS and some applications. Microsoft clustering works via a shared SCSI bus to attach two servers to the same disk subsystem, and it uses networking technology to let each server measure the other's health. Should one server sense that the other has died, the healthy server will take over the dead one's disks and start the failed applications without user intervention. Resources attached to the downed server will automatically be serviced by the healthy one. The Digital Clusters product works similarly—but only with Digital servers.

Applications such as Microsoft BackOffice, Microsoft Internet Information Server, and SQL Server are cluster-aware. Digital Clusters works with third-party products such as Lotus Domino and Notes servers as well.

PC clustering is not a panacea. These PC clustering products don't cluster more than two servers and lack some of the advanced bells and whistles of mainframe and minicomputer systems, such as application load balancing. PC clustering is still relatively new, and despite Microsoft's efforts, few applications include cluster-aware code to fail-over in clustered environments.

According to Microsoft, there will be clustering improvements in Windows 2000. Clustering services reportedly are standard in Windows 2000 Advanced Server, with improvements like support for rolling upgrades of OSs and layered products, more efficient algorithms for detecting network failures and recovery, as well as a cross-platform API for development and support of cluster-aware applications that can handle load balancing.—*Tony Pompili*

this roundup that currently offer an eight-way in-chassis upgrade for their servers. Although it was not available in time for testing, the HP upgrade will require motherboard and memory replacement.—AZ

Hitachi VisionBase 8460

\$62,000 street. Milpitas, CA; 800-448-2244, 408-546-8000;
www.hitachipc.com.

● If floor space is not at a premium, or if you like your servers more mobile, then you may opt for a pedestal-style server instead of a rack-based system. The Hitachi VisionBase 8460 (\$62,000 street) is such a pedestal unit, but consider it carefully. This server had some performance issues on our benchmark tests (see "What the Numbers Mean") and only approaches the levels of serviceability and manageability the other products in this roundup attained.

The Hitachi's poor ServerBench performance likely resulted from a problem with its disk subsystem. Good Server-

Bench results depend on client data being cached before the test run begins, and the Hitachi's disk subsystem wasn't feeding data to the system fast enough to be cached within the allotted test ramp-up time. We worked extensively with Hitachi to troubleshoot the problem, and it should be resolved by the time you read this.

The principal serviceability difference between the Hitachi system and the rack-based units in this roundup—save the HP—is that with the Hitachi, you need screwdrivers to get into the guts of the server and replace parts, although the processes aren't difficult. To get into the unit, for example, you simply remove the three screws in back holding the top lid in place, remove the lid, and pop off the magnet-held side panels. This provides access to the motherboard and slots on one side and the memory and CPUs on the other. Before you get to the motherboard, you need to remove a big, foam air baffle—a piece that could easily be dam-

aged, which would jeopardize server cooling. The power supplies are also easily accessible (no need to remove side panels), but they are secured by four screws each.

On the front of the unit, you'll find a locking door that protects the floppy disk drive, power switch, LCD, CD-ROM drive, and door to the drive cage. You also have three additional 5.25-inch bays for removable media. The internal drive array is locked behind another, separately keyed door. When that's opened, you gain access to the 12-disk, hot-swappable dual-backplaned array, which takes 9GB and 18GB Ultra Wide SCSI-2 disks. The array is attached to an older Mylex DAC960-PU RAID dual-channel controller. Hitachi plans to replace this controller with the new Mylex DAC1164-P, possibly by the time you read this.

This server has one advantage over most of its rack-constrained competitors: more PCI slots. It has five 64-bit and five

SUMMARY OF FEATURES

Pentium II Xeon/450 Servers

PC MAGAZINE
EDITORS' CHOICE

■ YES □ NO	Compaq ProLiant 6500	Dell PowerEdge 6350	HP NetServer LXr 8000	Nitachi VisionBase 8460	IBM Netfinity 7000 M10
Price of tested configuration	\$74,420 street	\$51,120 direct	\$61,260 street	\$62,000 street	\$62,990 street
Memory type	ECC EDO DRAM	ECC EDO DRAM	ECC EDO DRAM	ECC EDO DRAM	ECC EDO DRAM
Maximum installable RAM	4GB	4GB	8GB	8GB	8GB
Motherboard manufacturer	Compaq	Dell	HP/Intel	Intel	IBM
Motherboard chip set	Compaq	Intel NX82450	Intel NX82450	Intel NX82450	Intel NX82450
Network interface cards (interface)	Two Compaq FastEthernet-NIC NC3122 10/100 Mbps, dual-port (PCI)	Four Intel EtherExpress Pro 10/100 Mbps (PCI)	Four HP NetServer 10/100TX (PCI)	Four 3Com 3C980 10/100 Mbps (PCI)	Four IBM 10/100 EtherJet (PCI)
BIOS version	Compaq System BIOS-P11	Phoenix ROM BIOS, Version A00	Phoenix BIOS 4.0, Version 6.0	Phoenix BIOS 4.6, Version 8.0	IBM Netfinity BIOS, Version 1
DISK SUBSYSTEM					
Operating-system hard disk	8.2GB Seagate Cheetah ST118202LC (10,000 rpm)	9.1GB Seagate Cheetah ST39102LC (10,000 rpm)	9.1GB HP ST39102LC (10,000 rpm)	18.2GB Fujitsu MAA3182SC (7,200 rpm)	4.5GB Seagate Cheetah ST34502LC (10,000 rpm)
Data hard disks	Eight 18.2GB Seagate Cheetah ST118202LC (10,000 rpm)	Eight 9.1GB Seagate Cheetah ST39102LC (10,000 rpm)	Eight 18.2GB Seagate Cheetah ST118202LC (10,000 rpm)	Eight 18.2GB Fujitsu MAA3182SC (7,200 rpm)	Eight 18.2GB IBM DGHS (7,200 rpm)
Disk array cabinet	Compaq ProLiant Storage System U/E	Dell PowerVault 200S	3U NetServer Rack Storage/12	N/A	NetBAY3
Chassis hard-disk controller	Integrated Symbios 53C876 Dual Channel Ultra Wide SCSI III	Adaptec AIC 7890 Ultra Wide SCSI II	Integrated Symbios 53C896 Dual Channel Ultra Wide SCSI II	Adaptec AIC 7890 Dual Channel Ultra Wide SCSI II	Adaptec AIC 7895 Ultra II Wide SCSI
Disk array hard-disk controller	Compaq SmartArray 3200 Ultra Wide SCSI III	Dell PERC II Ultra LVD SCSI	HP NetRAID Adapter3Si Ultra Wide SCSI II	Mylex DAC960-PU Ultra Wide SCSI	IBM ServerRAID Ultra Wide SCSI
RAID levels supported by disk controller	0, 1, 4, 5, 0+1, 10	0, 1, 5, 10, 50	0, 1, 5	0, 1, 3, 5, 0+1, 10, 30, 50	0, 1, 5
RAID controller channels (internal/external)	1 / 2	2 / 4	3 / 2	2 / 2	1 / 2
RAID controller cache (installed/maximum)	64MB / 64MB	128MB / 128MB	16MB / 64MB	16MB / 32MB	32MB / 32MB
EXPANDABILITY					
Type of memory slots/number in use/total	DIMM / 16 / 16	DIMM / 16 / 16	DIMM / 8 / 32	DIMM / 16 / 32	DIMM / 32 / 32
Expansion bus slots	Five 64-bit PCI, one ISA/PCI (modem only)	Three 32-bit PCI, four 64-bit PCI	Six 32-bit PCI, four 64-bit PCI, one ISA/PCI	Five 32-bit PCI, five 64-bit PCI, one ISA/PCI	Seven 32-bit PCI, five 64-bit PCI
Front-accessible bays in chassis (5.25", 3.5")	3 / 1	2 / 1	1 / 1	4 / 1	1 / 1
Internal bays in chassis (5.25", 3.5")	0 / 0	0 / 0	0 / 0	0 / 1	0 / 0
Front-accessible disk drive bays (1", 1.6") (all hot-swappable)	7 / 5	3 / 0	2 / 0	12 / 12	4 / 0
Number of drives in external disk array (1", 1.6") (all hot-swappable)	12 / 8	8 / 8	8 / 8	N/A	10 / 10
SECURITY AND FAULT TOLERANCE					
Hot-swappable PCI slots in use/total	3 / 5	5 / 7	2 / 4	0 / 0	5 / 12
Lockable hard-disk subsystem/power switch	■ ■	■ ■	□ □	■ ■	■ ■
Suspend button/reset button	■ ■	■ ■	□ □	■ ■	■ ■
Lockable front panel/keyboard/chassis	■ ■ ■	■ □ ■	□ □ □	■ □ □	■ □ □
Temperature-sensor location	Hard disk, motherboard, processor	Motherboard	Hard disk, I/O card, power supply, processor	Motherboard	Processor card
Number of fans	4 chassis, 3 drive bay	3 chassis	6 chassis	9 chassis	4 chassis
Number of power supplies	2 chassis, 1 disk array	3 chassis, 2 disk array	3 chassis, 2 disk array	4 chassis	3 chassis, 2 disk array
SERVER MANAGEMENT					
Management software	Compaq Insight Manager	HP OpenView Client Administrator, NNM/SE, ManageX/SE	HP TopTools, HP OpenView ManageX/SE	Nitachi System Manager	IBM Netfinity Manager
Asset management/network management	■ ■	■ ■	■ ■	■ ■	■ ■
Fault tracking/Local alert via console	■ ■	■ ■	■ ■	■ ■	■ ■
Remote alert via SNMP/pager/modem	■ □ ■	■ ■ ■	■ ■ ■	■ ■ ■	■ ■ ■
Remote reboot	Optional	Optional	■	■	■
OTHER HARDWARE					
Graphics card	Integrated ATI Rage IIC PCI, 2MB RAM	Integrated ATI Rage 3D Pro, 2MB RAM	Integrated Cirrus Logic GD5446, 1MB RAM	Integrated Cirrus Logic GD5446, 1MB RAM	Integrated S3 Trio V2/GX SVGA, 1MB RAM
Bootable CD-ROM drive	32X IDE	32X SCSI	24X IDE	24X IDE	32X IDE
SERVICE AND SUPPORT					
24-hour, 7-day live technical support	■	■	■	■	■
Prefailure warranty coverage	Hard disk, memory, processors	Hard disk, memory	Hard disk	Hard disk	Hard disk
Warranty	3 years	3 years	3 years	3 years	3 years
Included on-site service	3 years	1 year (\$149)	3 years	3 years	3 years
Standard on-site service response time	Second business day	Next business day	Next business day	Next business day	Next business day

N/A—Not applicable: The product does not have this feature.

32-bit PCI slots, plus one shared ISA/32-bit PCI slot, all hot-swappable-ready. The unit also has four hot-swappable power supplies, each with its own cord. Three power supplies have to be in use at any given time, however. The server also has fan clusters designed to be removed easily. Again, though removal is not difficult, a screwdriver is required.

Hitachi System Manager (HSM) covers both local and remote management duties for this server under Windows NT. This fairly well-rounded package has hooks into the server's hardware, so either locally or remotely, you can monitor and configure a server's fans, CPUs, disk subsystems, and more, as well as cycle power to the server. HSM can also monitor servers enterprise-wide, and it can be configured to send SNMP traps and DMI information to higher-level management platforms such as HP OpenView and Novell's NMS.

Hitachi's System Setup Utility (SSU), though the sparsest such tool among the products we reviewed, does get the job done. Instead of being supplied on a boot CD, SSU comes in a three-disk set. This does the trick for configuring boards and system settings, but we miss the backup of the driver disks and the various utilities on the system setup CDs that the other vendors provide.—*RI*

IBM Netfinity 7000 M10

\$62,990 street. Somers, NY; 800-426-7255; www.ibm.com.



IBM packs plenty of power into its Intel server offering, combined with a number of extras leveraged from its experience in mission-critical systems. The IBM Netfinity 7000 M10 (\$62,990 street) had one of the best sustained throughput scores on our tests and includes Light-path diagnostics for troubleshooting, Hot-Plug Service for replacing or adding adapters on the fly, and Chip-kill memory technology for higher reliability—making the unit stand out and earn our Editors' Choice.

The server we tested came with the IBM NetBAY3, a stackable enclosure for the main unit and subsystems that takes a building-block approach (as opposed to a



IBM's Netfinity boasts high-availability features and unique technology such as its Light-path LEDs.

rack or pedestal). The enclosure fits under the Netfinity; you can stack up to three NetBAY3s. Within the enclosure you can load the disk subsystem, as in our case, or include other racklike components such as a UPS. IBM also offers traditional racks.

Getting at the system's components for service is easy: The CPU, the memory, the disk drives, and two out of four fans are all front-accessible. HP's NetServer RAM trays were the easiest to remove in this roundup, but IBM's were a close second. Popping off the top reveals the remaining cooling fans and all the PCI slots. The slots require no screwdriver for the insertion or removal of adapters; each device is held in place by a lock-down clip.

Like other tested servers, IBM provides component or slot LED indicators. We particularly liked the indicators on the SCSI cabling that let you know you've made the right connections. But IBM took visual troubleshooting one step farther with its Light-path diagnostics. When a component such as a DIMM fails, you're first alerted by a front-panel display of the fault, and then after removal of the cover, a Light-path set of LEDs leads you to the troubled part—a definite boon for rush service calls.

Inside the Netfinity, you'll find 12 hot-plug PCI slots (the highest density of any of the tested boxes). Though all the servers in this story are hot-plug-ready, only Com-

paq, HP, and IBM ship software solutions that make hot-swap PCI a reality. IBM goes one step further by providing hot-add PCI capability as well. There are also slots dedicated to the graphics and remote-management adapters. The unit uses the Netfinity ServeRAID 3H controller for disk redundancy, EtherJet 10/100 Ethernet cards with fail-over capabilities, and hot-swappable power supplies. For more processing power, the IBM server, like the HP, can be upgraded to eight CPUs.

Unique to the Netfinity is IBM's advanced ECC memory called *Chip-kill DRAM* technology. It lessens the hazard of data loss in system crashes stemming from memory corruption. Current ECC schemes can only sense double-bit errors but not correct them. Chip-kill adds a processor chip on each DIMM that protects the data in a method similar to RAID protection for disks, and it corrects multibit errors.

Management-wise, IBM covers the proverbial bases by offering the simple-to-use ServerGuide for setting up the system, and the Netfinity Manager software and the remote Advanced System Management PCI adapter for controlling it. We didn't find the Manager software as slick as HP's TopTools; although very functional, its OS/2-like interface looks somewhat dated. But the system does gather all necessary data, generates alerts when needed, and helps you with asset and capacity management. The software works with DMI and SNMP standards, and IBM claims integration with management packages such as Microsoft SMS and IBM's own Tivoli.

The built-in Advanced System Management adapter controls the server via a LAN or dial-in connection with the Management console or through a Web browser interface. All management functions work in conjunction with the Predictive Failure Analysis (PFA) to inform you of potential problems with memory, disks, CPUs, fans, and power supplies prior to failure. To extend the remote-management reach, the Remote Connect service automatically dials IBM (based on a service event) to resolve the problem or dispatch help, and the Update Connector automates BIOS- and driver-level updates from the vendor's Web site.—*Jeffrey G. Witt*

A representation of the big new advance in disk defragmentation. Courtesy of Morgan.



Call us neat freaks, but we think a mess that isn't totally cleaned up is still, well, a mess. Which is why Raxco presents new PerfectDisk™ 2000, the only tool that completely defragments enterprise-wide Windows 95/98/NT/2000 disks, for unheard-of performance.

Unlike other products that offer 80% defragmentation at best, PerfectDisk 2000 defragments 100% of disks, including paging files, directories, and master file tables—where file searches begin and bottlenecks often occur.

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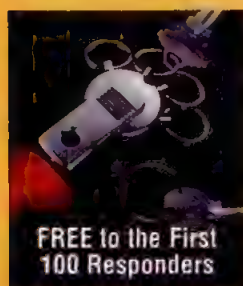
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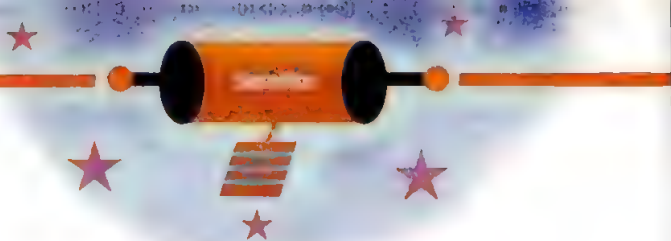


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THE Faster

By Les Freed and Frank J. Derfler, Jr.

DSL, cable modem, and satellite connections promise fast and constant access to the Internet. Which service is right for your needs?

All the excitement over fast Internet connections is really about only a couple of miles of wire. No matter where you live, you aren't too far from a fast pipe into the Internet, but the problem of how to extend that pipe the last few miles to your home or office occupies thousands of engineers, managers, politicians, and bureaucrats.

Three "last-mile" communications technologies—cable modems, digital subscriber line (DSL), and satellite—can provide fast Internet access for homes and businesses. Although they are based on vastly different concepts, all three deliver speeds many times those of conventional modems or ISDN lines. In addition, they can provide full-time, always-on connections that eliminate tedious modem dialing and log-on procedures.

As little as 18 months ago, we wondered aloud whether cable modem and DSL would get off the ground. The answer turned out to be a resounding and emphatic yes.

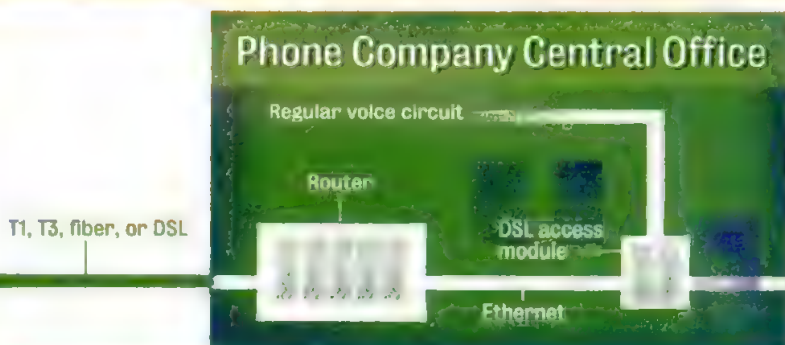
Virtually all of the major telecommunications companies have made major commitments to DSL technologies, as have the major networking equipment vendors. According to the Yankee Group, there were 425,000 two-way cable modem installations with Internet connections at the end of 1998 and 25,000 DSL customers. Yankee predicts 1 million cable modem and 250,000 DSL subscribers by the end of 1999.

REVIEW CRITERIA

For our evaluation, we ordered and tested different types of services at 12 locations around the country. Generally, we found that, if you can get it, cable modem service is a bargain for the residential user, though there are some service issues. ADSL performs well and is a good solution for small and medium-size businesses and their telecommuters. But it tends to be more expensive and is less widely available today. Satellite is a good solution where you can't

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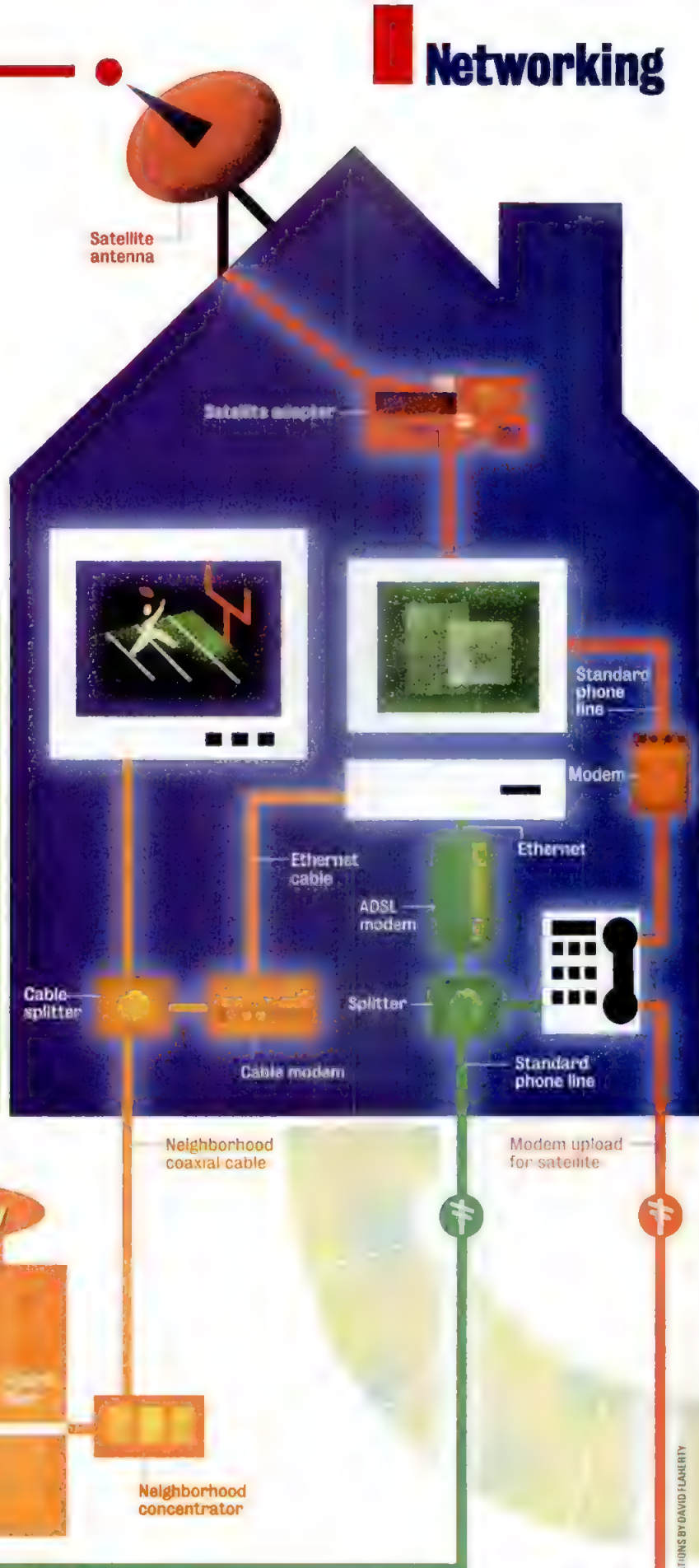
Web

Three different ways to connect from home.

CABLE MODEMS Primarily for residential users, cable modems connect over one channel of an upgraded cable television system. Connections are constant, with download and upload speeds as high as 4 Mbps or more. Cable is currently available to more users than ADSL and is expected to grow dramatically during 1999.

ADSL ADSL runs over existing phone wires, providing download speeds up to 8 Mbps (but usually closer to 1.5 Mbps). It's a constant connection, yet it doesn't interfere with your existing phone service. Availability is even spottier than cable, but incumbent and alternative phone companies predict a quick rollout this year for both business and residential customers.

SATELLITE If cable or ADSL is not available to you, there's always satellite—provided right now by Hughes DirecPC. Download speeds are up to 400 Mbps. Uploads require an analog phone line and standard modem. You also need a place to put a satellite dish.



Fast Connections Compared

	Service provider	Installation cost	Monthly cost	Download speed	Upload speed	Always on	Requires phone line	User can receive calls while line is in use	Limitations	User can choose ISP	Best use
56K analog	For phone line, local phone company; for service, independent ISP	Up to \$25; modem provided by user	\$19, plus cost of phone line	56 Kbps or less (depending on local line condition)	33.6 Kbps	No	Yes	No	None	Yes	Residential
ISDN	For phone line, local phone company; for service, independent ISP	\$100-\$300 (varies regionally)	Phone line: \$13-\$50 (plus per-minute usage charges in some areas); ISP: \$19-\$39	64 Kbps or 128 Kbps	64 Kbps or 128 Kbps	No	No	Yes	Must be within 19,000 feet of central office	Yes	Residential or business
ADSL	Local phone company, or choose among competitive local and inter-exchange carriers	\$100-\$500; modem, up to \$610	\$39-\$840 (may not include Internet connection)	144 Kbps-8 Mbps	144 Kbps-1.7 Mbps	Yes	Yes	Yes	Must be within 20,000 feet of central office; speed varies with distance	Yes	Residential or business
Cable modem	Local cable operator, often acting as agent for a national cable provider	Up to \$175; modem, up to \$349	\$34-\$49 (may include Internet connection)	384 Kbps-4 Mbps	128 Kbps-4 Mbps	Yes	No	Yes	Must have cable TV available	No	Residential or small-business
DirectPC satellite	DirectPC (Hughes Electronics, a division of GM)	\$300-\$800	\$29.99-\$129.99 (plus analog phone line and modem)	400 Kbps	33.6 Kbps	Yes (for download only)	Yes	Yes (except when uploading)	Requires outside antenna	No*	Residential
Fixed point wireless	At&T, iRat, Telecom, NextLink Communications, Teligent, WavePath Communications	Negotiated according to services used	Varies; services may include telephone, intranet, remote access, VPN	Residential: up to 4 Mbps; business, generally up to 1.555 Mbps	varies	Yes	Normally provide phone access	Yes (except when chosen as phone service)	Requires outside antenna	Yes	Business

* The user can choose a dial-up ISP for uploads but not for downloads.

get DSL or cable, but you'll need an analog modem and phone line for uploads. The costs for any of these fast services typically run between \$30 and \$150 per month for a single PC, though DSL service prices vary much more than cable prices. In most cases today, however, you won't have the choice, as availability of either service is still limited.



FULL SPEED AHEAD

All three of these technologies deliver speeds ranging from 7 to more than 50 times the speed of a conventional 56K modem. That extra speed translates into

faster downloading of today's Web content, and it also opens the door for higher-quality graphics, sound, and video content on the Web.

The additional bandwidth also makes it possible to use the Internet for other applications—such as high-quality video-conferencing and online backup—that aren't possible or practical with a 56K dial-up connection.

Though the increased speed is a big attraction for cable and DSL technologies, the always-on nature of these services will change the way you think about the Internet. Having a

New Content: Constant fast connections enable all kinds of new and improved streaming video, audio, and other multimedia content.

full-time connection makes a virtual private network (VPN) more practical, since a work-at-home user can keep a VPN connection to the company office network up all day long without worrying

about the cost and without tying up a phone line.

You can also use a cable or DSL connection to host your own Web site or FTP server, so you can have access to your own files while you're away from your home office. In addition, e-mail users can check their mail as often as they like without having to take time out to dial manually into their ISP.

Another technology, terrestrial microwave, will hit its stride in the next few years. Companies such as Teligent and WavePath already use microwave transmissions from small antennas to provide local Internet access, but the availability of this technology is very limited. These companies aim primarily at small and growing businesses that need flexibility and low investment costs. Many offer packages that include remote access, virtual private networks, and telephone service.

We don't expect that any one of these fast connection technologies will push aside all the others. Instead, each one will find its niche in business and residential installations.

Our Contributors: FRANK J. DERFLER, JR., is the senior networking editor and LES FREED a contributing editor of *PC Magazine*. KEVIN YOUNG was the project leader, and executive editor LEON ERLANGER was in charge of this story.

CABLE MODEMS



For about \$20 more per month per PC than a typical V.90 modem ISP connection, cable modems yielded 13 to 29 times the performance of V.90 on our throughput tests. When you measure dollars spent per Mbps performance, cable modem service comes out ahead of DSL and is available to many more users today. Cable modem availability is still very spotty, however, and because many businesses don't have cable television installed in their buildings, cable modems, which use one or more spare television channels of an upgraded cable TV infrastructure, are primarily a solution for residential users.

Cable modem service is provided by a partnership between national cable Internet access providers and local cable television providers. Nationally, @Home and Road Runner dominate the market, but we also tested services from MediaOne and Optimum Online. TCI, which is planning a merger with AT&T, owns 40 percent of @Home. Media giant Time Warner jointly owns Road Runner with Compaq Computer Corp., MediaOne Group, and Microsoft Corp. These corporations supply technical know-how, a fast Internet backbone connection, and marketing and billing assistance to hundreds of local cable television operators nationwide. They also provide specialized content and their own Web portals to end users. In almost all cases, your cable modem connection service is also your ISP.

Editors' Choice

• Cable modems



You probably won't be choosing among cable modem, DSL, and satellite services, because with the exception of satellite, these services have only limited

availability today.

The performance and relative value of a fast connection service depend strongly on your location and several other variables. Nevertheless, in most cases our tests showed cable modem services to be a better deal for the residential user today than DSL and satellite. Cost per Mbps on our performance tests was generally the lowest for cable modems, and though our cable modem reviewers had a few more installation and customer support problems than

DSL and satellite reviewers, they found performance in general to be excellent. BellSouth's ADSL service in Atlanta reached the same value as the cable services.

Since cable modems operate over the cable television infrastructure, they are available mostly to residential users. If you own or operate a small business, you'll probably find DSL more likely to be available than cable. And satellite is a good solution for locations where neither cable nor DSL services have yet arrived.

All of the homes in a given neighborhood share a single cable much the way PCs share an Ethernet LAN connection. Several neighborhood cables connect to a cable access unit (CAU), which combines signals from the neighborhood cables into a single signal. In turn, the CAU connects via a high-speed fiber-optic line to the cable company's main switching center housing the routers and providing the on-ramp to the Internet.

Today, there are two types of cable modems. Two-way hybrid fiber-coaxial

(HFC) modems can theoretically achieve download speeds in the 3-Mbps to 10-Mbps range with upload speeds of around 128 Kbps to 10 Mbps. One-way coaxial modems average a 2-Mbps download speed and require a dial-up modem for the upload of data. A few providers still use the one-way coaxial technology, but most have switched over to HFC.

Most cable modems connect to your PC via an Ethernet connection, so the cable company's installer must open your PC and install an Ethernet card if you



www.pcmag.com/hotlinks

There's no more comprehensive Internet coverage online than PC Magazine's. For a comprehensive guide to DSL and cable modem services by state, go to the URL above.

► International Telecommunications Union

<http://www.itu.int>
Based in Geneva, Switzerland, the

ITU approves the standards for the telecommunications industry. The ITU site has some good papers and speeches on the global telecommunications industry.

► CableModemInfo.Com

<http://www.cablemodeminfo.com/>
An excellent source for cable- and DSL-related links. It includes links to manufacturers of cable-modem-related software, including proxy servers.

► Security Considerations for Residential Broadband Access Services

<http://www.inetdev.org/19980721/ppframe.htm>

A good site covering DSL and cable modem generalities, with an emphasis on security and multiple connections in a residence.

► Cable Modem University

<http://www.cmv.org/modem>

This is a great site for nitty-gritty technology information, market research on the cable industry, and information on the availability of cable modem service.

► Cable Modem Resources on the Web

<http://rppc.mit.edu/~gingold/cable>

This MIT-sponsored site has lots of cable-related links, including cable modem manufacturers, periodicals, and testing sites.

► ADSL Forum

<http://www.adsl.com>

Information on upcoming ADSL conventions. This site is also an excellent repository of information on everything DSL, including current service availability.

► Universal ADSL Working Group

<http://www.uawg.com>

The UAWG has been working toward a universal ADSL modem standard. Go to this site to find out more about G.lite.

Cable Services in Major Metro Areas

Area	Services	Phone number	URL
Atlanta	@Home	650-569-5000	www.home.net/home
	Convergence.com	Contact local cable TV operator	www.convergence.com
	MediaOne Express	888-339-3160	www.mediaoneexpress.com
Boston	MediaOne Express	888-339-3160	www.mediaoneexpress.com
Chicago	MediaOne Express	888-339-3160	www.mediaoneexpress.com
Dallas	@Home	650-569-5000	www.home.net/home
Denver	Convergence.com	Contact local cable TV operator	www.convergence.com
	ISP Channel	888-843-1700	www.ispchannel.com
Houston	Not yet available	Contact local cable TV operator	
Los Angeles	@Home	650-569-5000	www.home.net/home
	ISP Channel	888-843-1700	www.ispchannel.com
	MediaOne Express	888-339-3160	www.mediaoneexpress.com
Miami	Convergence.com	Contact local cable TV operator	www.convergence.com
	PowerLink	888-233-5638	powerlink.adelphi.net
New York	@Home	650-569-5000	www.home.net/home
	Optimum Online	Contact local cable TV operator	www.optimumonline.com
Philadelphia	@Home	650-569-5000	www.home.net/home
Portland, OR	@Home	650-569-5000	www.home.net/home
St. Louis	EarthLink	800-327-8454	www.earthlink.com
San Francisco	@Home	650-569-5000	www.home.net/home
	Convergence.com	Contact local cable TV operator	www.convergence.com
San Jose	ISP Channel	888-843-1700	www.ispchannel.com
Seattle	@Home	650-569-5000	www.home.net/home
Tampa	Road Runner	Contact local cable TV operator	www.rr.com
Washington	@Home	650-569-5000	www.home.net/home

don't already have one. Sometimes the installation fee includes the modem and the Ethernet card, but you may have to buy or rent a cable modem from the cable company. Cable-modem hardware vendors include Cisco, General Instruments, Motorola, Samsung, and 3Com.

COMING TO A STORE NEAR YOU

Until this year, a lack of standards locked both the service provider and end users

into a single-vendor solution. A new industry standard called DOCSIS (Data Over Cable Service Internet Specification) was ratified last spring, and all of the major cable modem vendors intend to deliver DOCSIS-compliant modems in by summer of 1999.

In the few areas where DOCSIS modems are currently available, you can purchase a cable modem at a local computer store for \$150 to \$350, sign up for

the service either at the store or over the phone, and install the cable modem yourself—assuming you already have cable TV service. We expect this to become the norm over time, especially as USB-connected cable modems become more common, making installation of an Ethernet card unnecessary. For now, the local cable company usually sends an installer to your house to set up your cable modem service. You can receive cable modem and cable TV service on the same cable, so established cable TV subscribers usually don't need any additional inside wiring to connect a cable modem. Some cable providers give established cable TV subscribers a \$10-per-month discount.

Each time you turn on your PC, the cable modem automatically establishes a connection to the Internet. Just launch the same browser or e-mail application you would use for dial-up access. This high-speed, dedicated connection changes the way you think about the Web.

You won't hesitate downloading a game demo or new browser software. Since you don't have to wait 20 to 30 seconds for a connection, checking local traffic, weather, or sports scores online becomes much more practical. Work-at-home users will discover that a VPN running over a cable modem gives them the same access network resources and e-mail as their office-bound colleagues.

But though cable modems can provide stunning connect speeds, the service has a few caveats you should be aware of—

Glossary of Communications Terms

- **Central office (CO)** A telephone company facility that serves a specific geographic area. All phone lines run from a subscriber's home or office to a CO.
- **CLEC (Competitive Local Exchange Carrier)** A phone company that competes with the primary local exchange carrier (ILEC) in a given market. A company may be the ILEC in one market and CLEC in another.
- **Data Over Cable Service Interface Specification (DOCSIS)** A relatively new industry standard defining how cable modems communicate over cable TV lines. Any DOCSIS modem will work on any DOCSIS-compatible cable TV network.
- **Digital subscriber line (DSL)** A communications technology that provides high-speed, two-way data communications over existing analog phone lines. DSL doesn't interfere with the existing phone service on

the line, so you can still use your phone to place and receive calls at all times. There are several varieties of DSL, but the most widely deployed is ADSL (asymmetric DSL), which provides downstream speeds of 500 Kbps to 8.1 Mbps and upstream channels from 100 to 200 Kbps, depending on the user's distance from the phone company central office.

- **G.Lite** An ITU standard for DSL technology that delivers download throughput of up to 1.5 Mbps. G.Lite is expected to become the main standard for residential and small-business DSL service.
- **Headend** The cable TV equivalent of a phone company central office, the headend is the cable company's main signal reception and distribution facility. All TV cables for a given city route back to a single headend.

- **Incumbent Local Exchange Carrier (ILEC)** The primary local phone service provider for a given market. Also called an RBOC (Regional Bell Operating Company).

- **ISDN (Integrated Services Digital Network)** An all-digital replacement for analog telephone service. ISDN provides two 64-Kbps channels, which can be used together or independently to carry voice or data.

- **Virtual private network (VPN)** An authentication, encryption, and data-packaging technology that allows private network traffic to travel over the public Internet. VPNs provide remote-office and work-at-home users with secure access to a corporate LAN or WAN. VPN traffic is encrypted so that it cannot be deciphered as it travels over the Internet.



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Cable Modem Services: Sample Costs

Service	Home installation	Modem	Monthly charge	Network interface card
@Home www.home.net/home	\$99-\$175	Possible rental fee or purchase from local cable provider	\$29.95-\$49.95	Provided with modem
ISP Channel www.ispchannel.com	\$99	\$179-\$349	\$49.95 and up	User must provide
MediaOne Express www.mediaoneexpress.com	\$99.95	Rental included in the monthly service charge	\$39.95 for MediaOne cableTV customers; \$49.95 for other customers	\$49.95 from MediaOne or provided by user
Road Runner www.rr.com	Varies by area (generally \$99)	Rental included in the monthly service charge	Varies by area (generally \$39.95)	Provided with modem

Monthly service charges may be lower when the service has special promotions. All prices listed are for single-user unlimited usage.

namely slowdowns, bandwidth congestion, and lack of support for LANs.

Although your provider possesses an incredibly fast connection to the Internet, there can be times when the ISP-to-Internet link can reach near capacity, slowing your connection to a crawl.

If you have a home or small business LAN, your cable company may refuse to provide service. Home LANs can be difficult to troubleshoot, and some cable companies don't want the responsibility and added support burden. If you can get service for your home network at all, you may have to pay an extra installation fee and monthly service charge for sharing the cable connection.

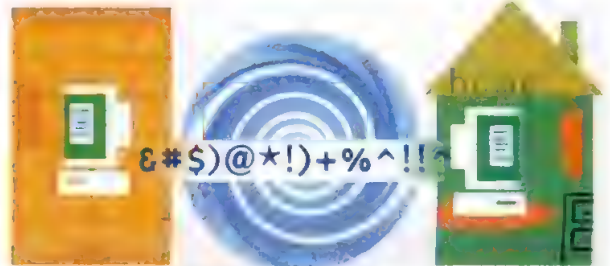
WHAT WE FOUND

We tested three leading cable modem services in seven locations: @Home in the Fremont, California, and Sarasota, Florida; MediaOne Express in Atlanta, in two suburban Boston locations, and in a Chicago suburb; and Optimum Online in Westport, Connecticut (New York City metropolitan area). Our reviewers wel-

comed the high-speed, always-on Internet access their cable modem provided, coupled with free Web-site hosting up to 5MB, and e-mail addresses (three each from @Home and four from Optimum Online). But unlike our DSL reviewers, several complained about slow technical support and customer service.

Our MediaOne and Optimum Online reviewers found out about cable modem service through advertisements and direct-mail pieces. The @Home reviewer

VPNs: Combine a fast Internet connection with a virtual private network (encrypted tunnel through the Internet) and you can stay connected to your office network at all times, making telecommuting much more practical than with an analog modem.



in Fremont had to call @Home several times to find out that the service was available. Once our reviewers placed their orders, it took anywhere from several days to two weeks to get cable modem service installed. @Home refused to install a cable modem in our Fremont, California, reviewer's PC, claiming it was too far from the cable entry into his house. But he managed to get connected by going out and buying his own 50-foot CAT 5 cable.

@Home's start-up page, the "In Sarasota" button at top leads to local content.

Installation for one of our metropolitan Boston reviewers took 3 hours because of compatibility difficulties with a 3Com EtherLink II network interface card. In Atlanta, a special MediaOne multi-dwelling task force had to jury-rig a new line down the outside wall of our reviewer's building, because the cable had been disconnected at the faceplate in his wall to prevent tenants from stealing cable TV. But our Sarasota-based @Home reviewer had a painless 1-hour installation within a few days of placing his order.

The Fremont, California, installation was divided between @Home and TCI, so our reviewer had two installation bills to pay. Conveniently, MediaOne takes care of the entire installation process, resulting in one installation bill. Each ISP reviewed offers a portal that displays customized information for the user's location. One reviewer in the Boston area leaves the computer on all the time so he can quickly check traffic cams to see what his morning commute has in store for him.

All services reviewed had some glitches. Many found slower speeds during the peak evening hours. Our Optimum Online reviewer needed to replace his modem

after a year (he was already connected prior to our testing). Our reviewer in Fremont bypasses the @Home proxy server and has set up his own DNS server because @Home's crashes frequently.

There were occasions when reviewers had technical problems and had to call a support line. In one instance, the San Francisco @Home reviewer stayed on hold with technical support for almost 40 minutes, only to be told that he would have to wait a week for a technician to come to his house. Our MediaOne reviewers also said that they had long hold times but felt their problems were resolved once they talked to a human being. Generally, despite concerns about customer support, our reviewers found cable modem service to be a bargain.





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www.hpprocurve.com/goodcurve.

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Cisco 2948-G	\$250 per port
3Com SuperStack II 3300	\$169 per port
Bay Networks 450T	\$170 per port

HP ProCurve 4000M U.S. list price effective 3/1/99. Savings claims based on U.S. list prices effective 2/22/99 for Cisco 2948-G, 3Com SuperStack II 3300 and Bay 450T. ©Hewlett-Packard.



DSL Services: Sample Costs

Service	Bandwidth (down/up)	Monthly charge	Connection charge	Modem cost	Installation fee
Bell Atlantic www.bellatlantic.com	640Kb / 90Kb 1.5Mb / 90Kb 7.1Mb / 680Kb	\$39.95 \$59.95 \$109.95	\$99	\$325	\$99
BellSouth www.bellsouth.com	Up to 1.5Mb / up to 256Kb	\$49.95* \$59.95	Included in price of modem	\$199.95	\$99.95
Concentric www.concentric.net	144Kb-180Kb / 144Kb-180Kb 384Kb-416Kb / 384Kb-416Kb 1.5Mb / 1.5Mb	\$149 \$199 \$499	Included in installation fee	\$425-\$610	\$125-\$375
Flashcom www.flashcom.com	200Kb / 200Kb 384Kb / 384Kb 784Kb / 784Kb 1.5Mb / 1.5Mb	\$89 \$139 \$199 \$349	Waived (or included in installation fee)	\$299 and up	384Kb, \$225; other bandwidths, fee waived
GTE www.gte.com	256Kb / 64Kb 384Kb / 384Kb 768Kb / 768Kb 1.5Mb / 768Kb	\$25 and up \$44 and up \$65 and up \$110 and up	\$80	\$300, or \$12 per month	\$140-\$300
Pacific Bell www.pacbell.com	384Kb / 128Kb 1.5Mb / 384Kb	\$39 \$129	Waived (with 1-year contract)	\$198	Waived (with 1-year contract)
Rhythms NetConnections www.rhythms.net	144Kb / 144Kb 384Kb / 384Kb 1Mb / 1Mb 7Mb / 1Mb	\$115 \$150 \$250 \$750	Included in installation fee	Included	With 1-year contract, \$500; with 2-year contract, \$250; with 3-year contract, free
U S West www.uswest.com	256Kb / 256Kb 512Kb / 512Kb 768Kb / 768Kb 1Mb / 1Mb 7Mb / 1Mb	\$40.00 \$62.40 \$76.80 \$120.00 \$840.00	\$110	\$199-\$299	\$149.95

Monthly service charges may vary if a service is offering a special promotion. All prices listed are for single-user unlimited usage.
* For BellSouth Complete Choice subscribers.

ADSL

Digital subscriber line uses existing telephone cable to move data from the Internet to your home or office at speeds ranging from 128 Kbps to a theoretical maximum of 8 Mbps. Unlike ISDN, which requires a dedicated pair of wires between the phone company and the user, DSL hitches a free ride over existing analog phone circuits. That signal doesn't interfere with phone service, so you can still use your phone, fax, or modem on the line as you always have.

There are many flavors of DSL, but the most common is ADSL. ADSL is asymmetric, with download speeds that are much higher than upload. Most DSL providers use tiered pricing based on different levels of download bandwidth (for more information, see the table "Sample DSL Service Fees"). The speed available to you will depend on your distance from the local phone company central office.

Our throughput tests of DSL services in four locations found speeds ranging from 4 to 25 times the speed of our V.90

connection. On the average, we found cable connections to be a better deal than DSL, but DSL is a more practical solution for business users, since many businesses don't have cable television installed in their buildings.

At your end of the connection, you'll need a DSL modem, which can be an external box paired with an internal Ethernet card or simply an internal DSL modem card. Either way, the DSL service provider will typically provide the modem. Internal DSL modems install in a PCI or ISA slot in your PC, much as ordinary dial-up modems do. PC vendors Compaq and Dell now offer factory-installed DSL modems as an option on their custom-built PCs. Compaq is offering standards-based modems, which won't be useful until summer 1999, when services start adhering to these new standards. Dell offers proprietary modems for particular services in particular locations today.

Various companies called Local Exchange Carriers, or LECs in telephone parlance, are waging economic, legalistic, and bureaucratic battles over the use of last-mile telephone cables to provide DSL. The ALECs (alternative LECs) or CLECs (competitive LECs) in your area, with names such as Covad and NorthPoint, are both challenging and cooperating with the local telephone company or Incumbent LEC (ILEC), such as Bell Atlantic and U S West, in a very complex courtship. You now can get—or shortly will be able to get—DSL from interexchange carriers (IXCs) such as Sprint and MCI (through UUnet.) For these reasons, you might find DSL available from several carriers in your area—or not available at all. (For more information, see the table "DSL Service Providers in Major Metro Areas.")

Many DSL providers also act as your Internet service provider. In some markets, however, you may purchase DSL service from your local phone company and Internet access from an independent ISP. And in some cases the ISP may act as your DSL provider.

THE EMERGING STANDARDS

In late 1998 and early 1999, the International Telecommunication Union (ITU) approved a group of ADSL standards. Most people will eventually use ADSL service delivered in a form called G.lite. G.lite will first appear in the summer of 1999 as telephone central offices and private buildings get new DSL service.



Videoconferencing: Cable modem connections provide the bandwidth for high-quality 30-fps videoconferencing over the Internet.

G.lite offers a maximum download rate of 1.5 Mbps and a maximum upload rate of 512 Kbps, but speeds will vary in individual installations. G.Lite will let phone companies get out of the business of selling or renting and, most important, installing DSL modems on users'



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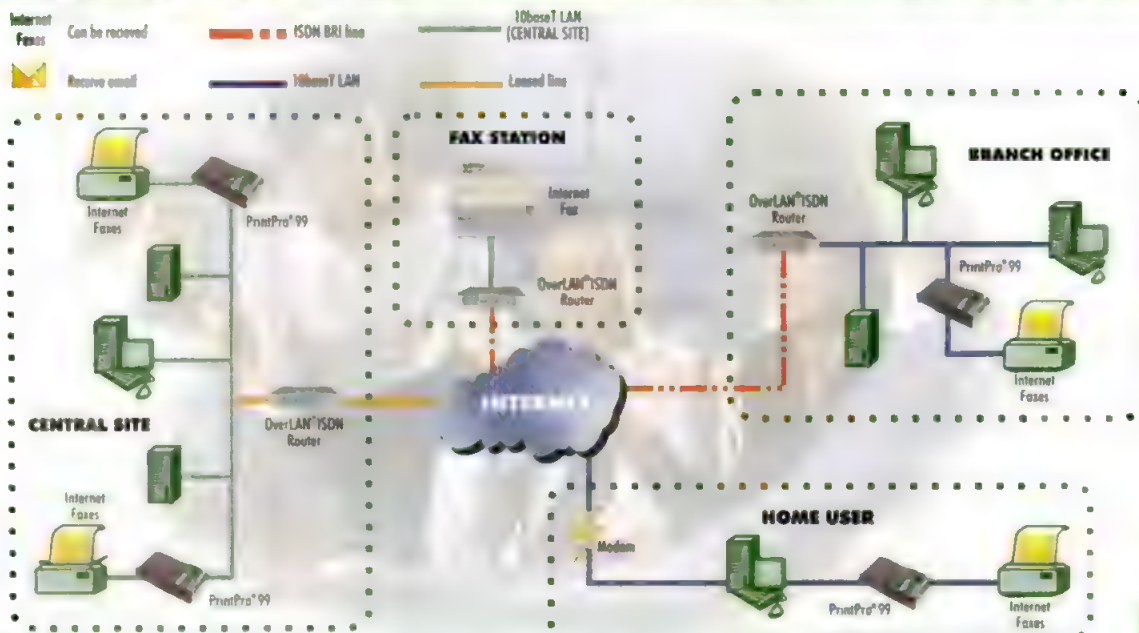
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Chicago American Information Systems, @Work, Concentric, Flashcom, NorthPoint, Rhythms, UUnet, Verio	Bell Atlantic Corp.	877-525-2375	www.bellatlantic.com
Dallas @Work, Concentric, DigitalSelect, Flashcom, GTE, Muse, Netcom, NorthPoint, Southwestern Bell, Telares, UUnet	BellSouth	404-249-2000	www.bellsouth.com
Denver Netcom, Telares, U S West, UUnet	Brainstorm Networks	650-567-6244	www.brainstorm.net
Houston Concentric, DigitalSelect, Muse, Netcom, NorthPoint	Concentric Network Corp.	888-493-6232	www.concentric.net
Los Angeles @Work, Concentric, Covad, DigitalSelect, Flashcom, GTE, IntelNet, Netcom, NorthPoint, Orconet, Pacific Bell, Rhythms, UUnet, Verio, Zyan	Covad Communications Co	888-462-6823	www.covad.com
Miami @Work, DigitalSelect, Flashcom, UUnet	DigitalSelect LLC	800-900-7567	www.digitalselect.net
New York @Work, Bell Atlantic, Concentric, Covad, DigitalSelect, Flashcom, NorthPoint, Red, Rhythms, UUnet, Verio	Flashcom	877-352-7426	www.flashcom.com
Philadelphia @Work, Bell Atlantic	GTE Service Corp	800-555-4833	www.gte.com
Portland, OR @Work, GTE, Telares, U S West, UUnet	IntelNet Communications Inc.	888-787-7979	www.intelnet.net
St. Louis @Work	Ionix Technology Corp.	415-288-9940	www.ionix.net
San Francisco @Work, Brainstorm Networks, Concentric, Covad, DigitalSelect, Flashcom, Ionix, Muse, Netcom, NorthPoint, Orconet, Pacific Bell, Rhythms, UUnet, Verio	Muse Communications Co	214-821-7909	www.musecommunications.com
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Seattle @Work, Flashcom, GTE, Orconet, Telares, U S West, UUnet, Verio	NorthPoint Communications Inc.	415-403-4003	www.northpointcom.com
Tampa, FL GTE, UUnet	Orconet	877-672-6638	www.orconet.com
Washington @Work, Bell Atlantic, Concentric, Covad, DigitalSelect, Flashcom, NorthPoint, UUnet	Pacific Bell	800-310-2355	www.pacbell.com
	Red	888-733-2000	www.redconnect.net
	Rhythms NetConnections	800-749-8467	www.rhythms.net
	Shore Net	781-477-2000	www.shore.net
	Southwestern Bell	888-294-8433	www.swbell.com
	Telares, Internet Global Services Inc	888-221-1335	www.telares.com
	U S West	See below*	www.uswest.com
	UUnet, an MCI WorldCom Company	800-488-6383	www.uunet.com
	Verio Inc.	888-438-8374	www.verio.com
	WinStar iCi	800-234-0002	www.ici.net
	Zyan Communications	800-205-4884	www.zyan.com

* For residential, 800-244-1111, for small business, 800-603-6000, for home office, 800-858-9675

premises. Instead, users will purchase modems from third parties (mail order, computer superstore, and so on) and install the modems on their own, then take the modems with them when they move to other locations.

WHAT WE FOUND

We signed up for ADSL services in three locations: Bell Atlantic's InfoSpeed service in northern New Jersey (near New York City), BellSouth FastAccess in downtown Atlanta, and a combination of Sirius (a local ISP) and Covad (a competitive exchange carrier) in the San Francisco Bay Area. All were ADSL. We also signed up for IDSL service, which gives you 144-Mbps uploads and downloads, in Foster City, California.

If you have ADSL service available in your area, then one or more companies

has probably sent you mail or called to tell you about it. These service providers vary in how they connect their central offices to the Internet. Unfortunately, you have no way to judge these back-end connections and we can only generalize, saying that they change and evolve frequently.

Competition brings aggressive pricing. While the "standard" DSL package might call for installation and equipment fees of \$200 to \$600, there are many special deals. Our reviewers found \$325 DSL devices promoted for \$99 and other promotional offers that waived installation fees. Similarly, monthly fees for DSL vary depending on factors such as your local telephone service plan and whether the DSL service provider is also the telephone service provider. Overall services charges, including ISP service, run in the range of \$49 to \$150 per month

for a maximum of 1.5-Mbps download speed with 384 Kbps guaranteed. Across the country, ADSL typically costs about \$10 to \$20 more per month than cable modems while offering slower service.

The throughput our reviewers received from DSL varied widely. One DSL installation, from BellSouth in Atlanta, provided better throughput than the average of cable modems across the country, but typical DSL throughput was much less. If you live in one of the tiny slices of the country where both services are available, then a cable modem is probably a better deal.

In some cases the installation required two visits—one from the telephone company to check the lines for DSL and one from the DSL provider to perform the installation; but our DSL users did not have the same complaints about service



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Ten Things to Know Before You Call

- 1 Does your PC already have an Ethernet card? The service may ask you to pay for another Ethernet adapter even if you already have one.
- 2 If you don't already have an Ethernet card, do you have a free PCI expansion slot? Cable, DSL, and satellite connections commonly use a PCI card.
- 3 Do you have USB in the computer and a USB-compatible operating system? USB-equipped cable modem, DSL, and satellite devices are just emerging. If you use USB, you don't have to open the PC.
- 4 Do you want to use a special service such as AOL? Some access schemes require a significant work-around to use AOL or other proprietary service providers.
- 5 Do you already have a local area network? Many cable modem and DSL installations will disable an existing LAN connection.
- 6 For cable modem: If you already have cable television, where does the cable come into the building and how is it distributed? You should try to eliminate splitters not installed by the cable company. Cable TV distribution amplifiers, often found in apartment buildings, can cause problems.
- 7 For cable modem: Is a cable outlet convenient to your computer?
- 8 For DSL: How is your telephone wiring distributed? You can incur significant charges for changing inside wiring.
- 9 For satellite: Do you have a clear view of the southern sky at an angle of about 45 degrees up from the horizon? The antenna can sit on the ground or on a roof, as long as it can see a specific patch of sky.
- 10 For satellite: How can the installer bring in a cable from the antenna and reach your computer?

that many of our cable users had.

As the sophistication of your computer system goes up, so does the potential for installation problems. We saw an installer confused by Windows NT, and we saw a nearly universal policy of disconnecting or at least disallowing responsibility for any connection to a local area network. But in our discussions with the companies, they say that they are putting agreements in place for proxy and firewall software.

While DSL is great for pulling down Web pages, it doesn't do as well at serving them up. Typically, DSL is delivered as an asymmetrical service. Our experience shows that you could put up a successful "friends and family" Web site, but that no personal DSL service will let you set up a busy Web site. A personal DSL service is not the right pipe for an e-commerce Web site, but DSL providers can offer faster and more expensive services without upload restrictions.

SATELLITE

Satellite systems go a long way to get around the last mile, but they'll work where no other fast Internet connection alternative is available, provided you have an unblocked view of the southern sky and are willing to use a regular phone line

for uploads via analog modem.

Hughes Network Systems' DirecPC, the only practical consumer Internet satellite system available right now, sends your download data streaming through space at a maximum speed of 400 Kbps. We found that the service is reliable and that a new USB receiver makes installation a snap if you have the right connections and operating system in your PC.

The Hughes DirecPC system has been on the market for over two years, but Hughes originally gave the service a complex pricing scheme that killed its acceptance. DirecPC 2.0, now available through retail outlets, has pricing you can understand. At the time of testing, we could buy the DirecPC dish and PC Card receiver for about \$200 out-of-

pocket after rebates. The company offers three levels of service: \$29.99 per month for 25 hours, \$49.99 for 100 hours per month, and \$129.99 for 200 hours per month. If you go over your monthly time limit, you pay \$1.99 for each additional hour. When you compare these prices with those of other services, it's important to note that the charges now include ISP service and an e-mail account (four e-mail accounts if you pay the \$129.99 monthly fee).

The DirecPC system works by downloading Web data through the satellite at high speed while uploading through a traditional dial-up modem and telephone line. The DirecPC driver software separates your incoming and outgoing IP traffic and routes it over the appropriate path. The limitations on usage time apply to the dial-up link.

Some applications, such as Domain Name Server lookup and some e-mail applications, can't tolerate the split Earth/space path, so you can use the setup program to route some specific IP functions only over the ground path. Interestingly, our Ziff-Davis corporate VPN software worked fine across the split path, so DirecPC is a viable alternative for corporate remote access.

Like @Home, DirecPC has suffered some abuse. The company found that a small percentage of users were downloading more than 10GB of data per month. This heavy drain limits the available throughput for others, so the company developed what is called a Fair Access Policy. Throttling software kicks in to limit downloads exceeding an unpublished set of parameters.

Epoch Networks provides the ISP upload access for DirecPC. This major ISP has a long list of local access numbers.

If you don't want access through Epoch—perhaps you have a local ISP with more connection numbers or no toll charges—you can use any ISP except AOL, CompuServe and Prodigy for the ground connection. You'll find, however, that you'll have to reconfigure options in your ISP's client software.

BellSouth's portal includes a local events calendar, online discussion, and traffic cams.



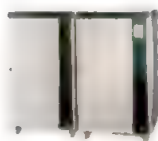
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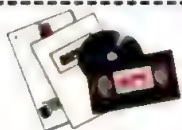
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BENCHMARK TESTS

Fast Connections



Cable modem services generally outperformed DSL and satellite connections; they usually represent a better value.

Service performance can vary according to location, distance from the service provider, availability, time of day, and several other variables. Nevertheless, these performance graphs give you a taste of the level of performance you can expect from different types of fast connection services.

The bar graph for Straight FTP Throughput shows the results of a test in which each reviewer downloaded Netscape Communicator 4.5 across the Internet from a special dedicated server. Cable outpaced DSL but did not reach the multimegabit speeds the cable companies claimed.

The last column displays the cost per Mbps, based on monthly service costs, of realized throughput for each service. Interestingly, though they tend to have lower costs, services with slower speeds are actually fairly expensive on a per-Mbps throughput basis. While value varied by location, in most cases cable service showed a lower monthly cost per Mbps than DSL or satellite. And DSL showed a much wider variation, from \$115 to \$1,091, compared with \$67 to \$184 for cable.

We collected a number of hops to our server, ping times, and some trending information. We found that performance strongly depends on where you live. Even within the same service,



ping times varied quite a bit. In nearly all cases there were periods when service would cease, though blackouts lasted at most a few minutes.

The most obvious result is that these services are fast, ranging from 4 to 30 times as fast as a 56K analog modem.

Applications bundled with DirecPC provide an off-line reader for popular sites such as ABC News, The Weather Channel, USA Today, ZDNet, and many others. These downloads take place through the satellite receiver during off-peak hours.

There are two versions of the DirecPC receiver: a PCI card and an external USB box the size of an analog modem. If your PC has a USB port and your operating system works with USB, like Windows 98, then the USB device is a better choice, because it's much easier to install. The PCI receiver card

requires a PCI slot, but it operates with Windows 95/98 or NT. We installed the receiver drivers under both Windows 98 and NT 4.0 on 233-MHz and 333-MHz PCs.

The DirecPC dish is slightly larger and more oval-shaped than the DirecTV dish you see on many homes. You can

add DirecTV to the DirecPC dish (but not the other way around) in a combination called DirecDuo. DirecDuo sells for a list price of \$499 if you already own the DirecTV satellite receiver and you want



Online Backup: High-speed connections make online backup of both desktop PCs and servers much more practical, letting you store backups off-site.

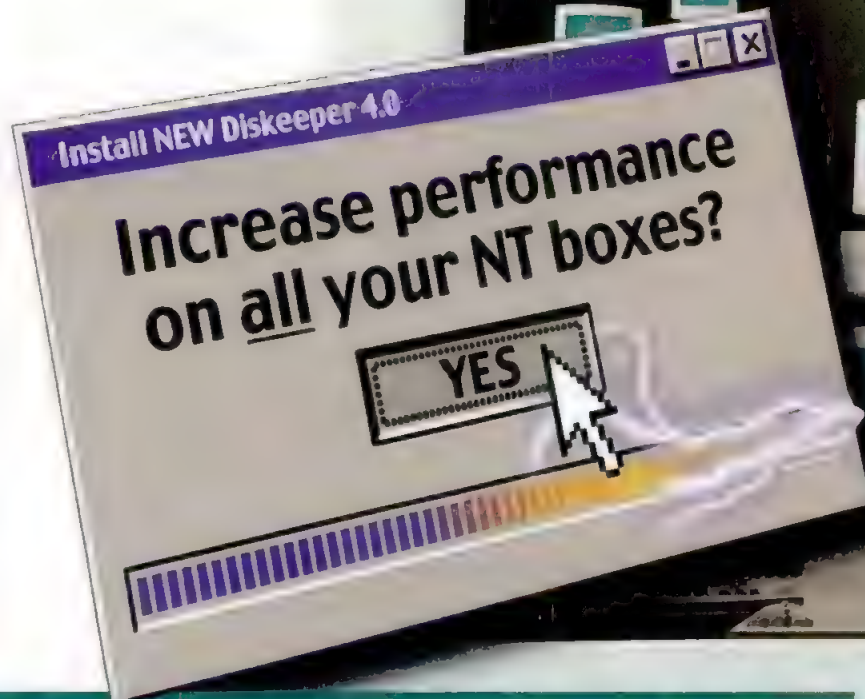
to add on the DirecPC. If you are starting with nothing, the list price is between \$799 and \$899 for DirecDuo. Various rebates and deals are common.

We did a do-it-yourself installation and had a professional installation done in another location. If you would consider

putting up your own ceiling fan, you could handle the dish installation. But don't count on simply pointing the dish out a window toward the south. You need a clear view of a very specific spot in the southern sky that you'll find with a compass and specific instructions. The professional installation took several hours, including the time needed for a pole to set in concrete, but it went without a glitch. Placing the antenna is the biggest challenge in installing DirecPC.

DirecPC suffers by comparison in most throughput tests because of the time needed to travel over the space link. The minimal built-in time for a ping request is 400 to 600 ms. Interactive tests like Any Speed show terrible results. Satellites are best for streaming downloads such as big files and graphics. Sustained speeds of about 225 Kbps were typical with big files.

The new DirecPC 2.0 pricing scheme has turned this Internet satellite service around by 180 degrees. It's fast, useful, and affordable. **PC**



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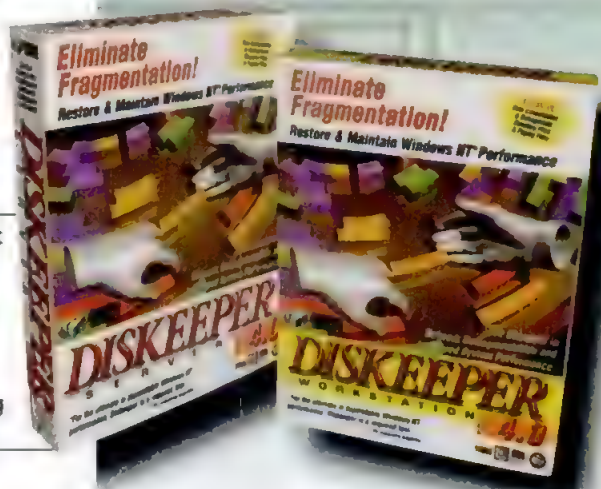
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SOLUTIONS

TUTOR

Laser Printers



Understanding how your printer works can help you get the most out of it.

By Alfred Poor

The very tools that once seemed to promise a paperless office now flood us in a sea of output, most of it arriving via the millions of laser printers in use around the world. We can print at the touch of a button, but getting good-looking output is not always as easy. You'll have a head start, though, if you understand the basics of how lasers work.

A laser printer essentially works like a standard photocopier. Both rely on light-sensitive drums to pick up toner particles and transfer them to a sheet of paper. First, light hits the drum. In a photocopier, lenses focus an image of the source document and shine it on the drum. In a laser printer, the printer's controller translates the print data stream into patterns of dots. This information is then used to turn the laser beam on and off as it is reflected from a rotating, faceted, cylindrical mirror. The shape of the spinning, faceted, cylindrical mirror causes the laser light to play across the face of the imaging drum, line by line.

When the light strikes the drum's surface, it changes the electrical charge of the photosensitive coating. As the drum rotates, these charged areas pass by the *developer module*, where the toner has been stirred to ensure even distribution. The toner particles are also given an electrical charge, so they are attracted to the opposite-charged portions of the drum. As the surface of the drum passes the developer, toner particles adhere to the drum where it has been exposed to light.

Other methods besides lasers have been used to expose the image on the drum in printers. Some designs have used a long array of light-emitting diodes (LEDs). Others have relied on a bright light behind a matrix of liquid crystal display (LCD) cells that act as shutters to either block the light or let it pass through. But as printers have become faster and users have demanded higher and higher resolutions, lasers have proven themselves best suited for the task.

While the drum is being exposed and picking up toner, a sheet of paper starts on its path through the printer. Before it reaches the drum, it passes near a charged wire called a *corona wire*, which imparts a static charge. This charge helps the oppositely charged toner adhere to the paper as it passes by the rotating drum.

Many factors affect how well the paper holds this charge, but the most important is moisture content. If the paper is too dry, the charge will be too great and the toner may spread or splatter when transferred to the paper. If the paper has too much moisture, then it won't hold a charge as well, and the toner may not transfer to the page as effectively. For this reason, you are best off using paper from a fresh ream and storing open reams of paper in a low-humidity environment.

More on the Web:

You'll find all of the articles, examples, and code files in this section at PC Tech online.

www.pcmag.com/pcotech

USER TO USER



More on editing links in IE4; differences between connecting networks using twisted-pair and coaxial cable; deleting and modifying Registry keys; stripping carriage returns in Word 97; Excel calculations on date/time values; and more. *Page 185.*



UTILITIES

Startup Cop lets you decide which programs should run

when you start your Windows system. And it's not just a matter of checking the Startup folder: There are six other places where you can tell Windows to run a program at start-up. *Page 192.*

ENTERPRISE COMPUTING

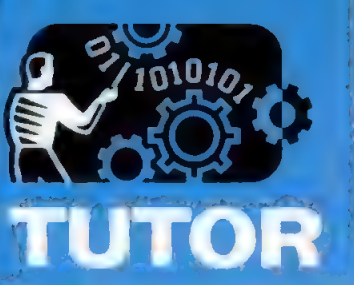


With the advent of Enterprise JavaBeans and CORBA 3.0-based products, and with Microsoft's forthcoming COM+ technology, components may finally start to give high-level application designers a quantum boost in reusability of code and reliability of multitier operation. *Page 195.*

PC TECH



Digital certificates and public key encryption are taking on a greater role in securing Web and e-mail communications between individuals and organizations. *Page 203.*



After the toner has been transferred to the paper, a light uniformly exposes the drum, and a corona wire neutralizes the charge on the drum's surface in preparation for the next write pass by the laser beam.

The toner is still a dry powder when transferred to the paper. The page then passes through a *fuser assembly*, where it is subjected to a combination of heat and pressure. This causes the toner to actually melt onto the paper's surface.

TONER AND PAPER

The toner melts because it is largely plastic. It is made by creating a "soup" of polystyrene and adding pigments to the nearly clear material. The most common toner color is black (though color lasers now also use cyan, magenta, and yellow), and in large part, the black color comes from carbon—essentially the same as soot. In order to give the toner the electromagnetic attributes required to handle the electrostatic charges correctly, iron oxide is added to the mix.

Once the pigments thoroughly blend with the plastic, the mixture is cooled into large bricks. These bricks are ground into pieces, and then they are milled and sifted to create a powder of uniform particles. The particles must be large enough to be handled by the printer's toner distribution system but small enough to provide even coverage and to meet the printer's resolution requirements. The mix is then ready to be loaded into print cartridges or toner refills.

The fact that the toner must be melted onto the surface of the paper has important implications for the paper used with the printer. Some papers, such as classic laid bond, have a textured surface with distinct ridges and grooves. Toner is deposited in both the high and low spots, but the fuser rollers may not exert sufficient pressure to reach into the depressions. As a result, the toner can adhere in some places, but in other places it can remain a powder that can be brushed off during normal handling.

Paper surfaces that are too hard and smooth don't work well either. With too few fibers to adhere to, the toner is melted into

place on the surface of the paper and is then prone to cracking and flaking, especially where the page is folded. Glossy coated papers are especially vulnerable. Most printers come with detailed specifications and recommendations for the paper to be used with them.

RESOLVING DIFFERENCES

When most people shop for a printer, they consider two key factors: speed and resolution. Speed is fairly straight-forward; most

resolution enhancement takes different forms, but typically involves varying dot size or position. By varying the length of exposure time, the printer can create larger or smaller dots on a page. And by varying the times when the laser fires to expose the drum, the printer can adjust a dot's position slightly to the left or right of its normal spot.

These two techniques make it possible to reduce the stair-step effect seen in nearly horizontal or vertical lines, also known as *aliasing* or *jaggies*. The use of different-size dots and different horizontal positions can make these lines appear smoother and unbroken.

These techniques also improve the printer's ability to *dither*. Dithering is the process by which a black-and-white printer can simulate shades of gray, and by which color printers can produce a rainbow of shades from just three or four ink colors. Dithering uses carefully

spaced patterns of ink that appear as various shades, just as a pattern of tiny dots in a newspaper or magazine photo creates the illusion of a continuous-tone picture.

Another factor that influences the true resolution of a printer is toner dot size. If the toner dots are too small, tiny gaps will occur between them, and you won't get smooth areas of solid color. To prevent this, the dots are designed to overlap slightly. If the dots are

too big, however, the printer won't be able to create single-dot-width lines spaced one dot apart, because the overlap will fill the space between the lines.

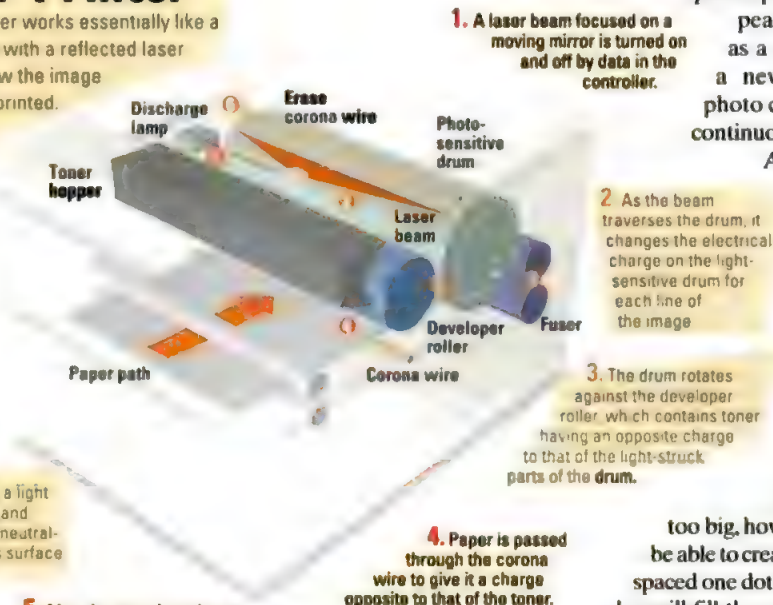
Other factors affecting output include the circuitry's ability to control the laser beam accurately, turning it on and off fast enough to create the right-size dot in the right location. And as mentioned above, the toner must have the correct characteristics to create sufficiently small dots without spattering areas that are supposed to remain blank.

Thus the effective resolution of a printer may be quite a bit lower than the rating based on the print engine's addressable resolution. Probably the best way to evaluate a printer's effective resolution is to examine a variety of print samples closely and compare them with samples from other printers. **PC**

Alfred Poor is a contributing editor of PC Magazine.

Laser Printer

A laser printer works essentially like a photocopier with a reflected laser beam to draw the image that will be printed.



manufacturers specify an *engine speed*, which

describes how quickly the printer can process pages of the same image (eliminating the time required to transfer an image from the printer and translate it within the controller).

Resolution is not nearly so simple, however. One factor in this complex issue is *addressable resolution*, measured in dots per inch (dpi). This refers to the number of dots the printer can create in a linear inch. Think of this as a grid defining all the locations on a page where a dot may be placed, much like the grid of pixel locations on a computer monitor.

The practice of *resolution enhancement* makes this issue even more complicated. Res-

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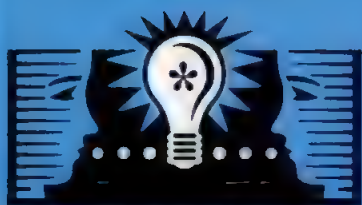
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USER TO USER

Editing Links in IE4 Revisited

With regard to the item "Edit IE4 Link Names" in the User to User column in the November 3, 1998 issue (www.zdnet.com/pcmag/pctech/content/solutions/uu1719b.htm), there is indeed a way to rename your links within IE4 even after they are on your Link bar. Just click on the Favorites menu, then select Organize Favorites. In the next

PC Many readers wrote to point out this possibility. Yes, the *Links* menu under the *Favorites* menu does indeed reference the same set of shortcuts as the *Links* toolbar, and you can manipulate them via *Organize Favorites*. In fact, once you have the *Links* folder open, you can right-click an item, choose *Properties* from the pop-up menu, and change its icon using the *Change Icon* button in the resulting dialog.

Before closing the *Links* menu, try this:



FIGURE 1: Adding a subfolder to the *Links* folder gives the *Links* toolbar a pop-up subtoolbar.

dialog box you'll see a list of all the items in your Favorites list, as well as a *Links* folder. Open the folder; you can rename any item in it using the *Rename* button. It's that simple. You can also use the same dialog box to rename any of the items found in your Favorites list.

James E. Treacy, Jr.
Tuscaloosa, Alabama

Right-click an unoccupied area and choose *New | Folder* from the pop-up menu. Give the folder any name you like, and drag a few of your links into it. When you click this item on the *Links* toolbar, you'll get a kind of pop-up subtoolbar (Figure 1). This can be quite handy if you have a lot of items in your *Links* toolbar. One warning: you can't go any deeper

than a single level of subtoolbar. If you create a folder within your subtoolbar folder, clicking the resulting item will simply open the folder in Windows Explorer. If you don't like the effect, just *Organize Favorites* again and put the links back to the way they were. —Neil J. Rubenking

Not Twisted

I want to set up a peer-to-peer network with Windows 95, but everything I read describes "twisted-pair" cabling. My network adapter cards have connectors for coaxial cable; how can I connect these?

Andy Shott
via the Internet

PC The Ethernet specifications actually offer a number of different choices for cabling. The most popular these days is certainly the twisted-pair cable, used for 10Base-T and 100Base-T connections. The other common choice is coaxial cable, used for 10Base2. There are some important differences between the two.

Twisted pair connects using RJ-45 modular plugs, which look like wider versions of standard telephone jack connectors. Twisted-pair Ethernet requires that you use a central hub to connect the computers on the network; each computer has a cable that runs directly to the hub. If you need to connect more devices, you can connect one hub to another. (If you have only two computers that you want to connect, you can connect them directly without a hub using a *crossover* cable.)

Coaxial cable has a different set of requirements. It connects using a bayonet-style connector, known as a *BNC* connector. It does not rely on hubs; instead the computers are daisy-chained. A T-shape connector is attached to each network adapter, and cables connect the devices. At either end of the chain the T-connector must have a terminating resistor attached. The cable must be RG58 (which is different from other coax cable types you might find, such as that used for cable television connections), and the terminating resistors must be 50 ohm.

There are advantages and disadvantages to the coaxial approach. If you want to add or remove systems on the network, you have to change the cabling to the adjacent systems in the chain, instead of just adding or removing a single cable to a central hub. Also, if there is a bad cable or connection, it can prevent the entire network from functioning (which can lead to a difficult troubleshooting task), whereas a bad twisted-pair cable typically affects only a single system. On the other hand, a coaxial

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network can run about 600 feet, but a twisted-pair cable cannot be longer than about 325 feet.—*Alfred Poor*

Modifying the Run Registry Key

I read "Getting Rid of Hidden Launch Items" in the November 1998 issue of *PC Magazine* (UK edition), and found it very useful. I do have a question, though. The way to stop all applications in the Run key from loading is quite clear, but I'd like to know how to deal with individual keys in that folder. Is it a matter of deleting the whole key, or can you disable the key by inserting a character, like prefixing lines with a semicolon in a Windows INI file?

Malcolm Walker
United Kingdom

PC You can find the item referenced above at www.pcmag.com/pctech/content/solutions/oel715b.htm. This article points out that you can disable a Run key entirely by changing its name to ".Run". There are at least three Run keys: HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Run, HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Run, and HKEY_USERS\Default\Software\Microsoft\Windows\CurrentVersion\Run.

In Microsoft Windows 98, the System Configuration utility automates the process of enabling and disabling start-up items of all kinds. When you choose to disable an item that resides in one of the Run keys, it moves the value representing that item into a new key with a minus sign appended to the name, for example HKEY_LOCAL_MACHINE\Software\Microsoft\Windows\CurrentVersion\Run-. You'd do well to follow the same pattern; here's how.

In Regedit, highlight the Run key that contains the item you want to remove. Select *Export Registry File* from the *Registry* menu, and export that key to a file named Run.reg. Now copy Run.reg to Run-.reg. Load Run.reg into Notepad. The first line will contain the string REGEDIT4, the second will be blank, and the third will contain the full name of the Run key, enclosed in square brackets. The remaining lines will have the form "Name"="program.exe".

Delete each such line that identifies a program you want to suppress, and save Run.reg. Now delete everything from Run-.reg *except* the lines you want to suppress, and also change the end of the third line from "...Run]" to "...Run-]".

Back in Regedit, delete the Run key, then im-



port both REG files. In the future, if you want to disable a particular item, export the Run key to Run.reg and the corresponding Run-key to Run-.reg, and move the item from Run.reg to Run-.reg. To enable an item, do the reverse. In either case, after saving both files delete the Run and the Run- keys using Regedit. Finally, import both REG files again. —*Neil J. Rubenking*

A Better Way to Delete Registry Keys

The interesting item "Automate Deletions from the Windows 95 Registry" in the User-to-User column of November 3, 1998 (www.zdnet.com/pcmag/pctech/content/solutions/uu1719a.htm), concerned deleting the Netscape Navigator URL History key from the Windows 95 registry. I immediately thought of an alternative to the INF file solution—Microsoft's Windows Scripting Host (WSH). WSH has been billed as the replacement for DOS batch files, and it comes with Microsoft Windows 98. To use it with Win 95 or Win NT 4.0 you'll have to download WSH from Microsoft's Web site and install it. The download includes some sample script files and a programmer's reference document.

Here's a script that will delete the above-mentioned key:

```
Option Explicit
Dim WSHShell
Set WSHShell =
WScript.CreateObject("WScript.Shell")
On Error Resume Next
WSHShell.RegDelete
"HKCU\Software\Netscape\Netscape
Navigator\URL History\"
WSHShell.Popup "URL History deleted",
60, "Done", 64
```

It is written with VBScript (JScript can also be used). I've included the On Error Resume Next statement so that the script will continue even if the key does not exist (or has already been deleted). Because Run is the default action, you can run the file by double-clicking it in Windows Explorer. You can also run it from the Windows command line or DOS.

WSH and VBScript can be great tools for power users. You can use WSH to read and write registry keys, map and disconnect network drives, create shortcuts, and a lot more. VBScript lets you

create some fairly complex programs for working with drives, folders, and files. You can write functions and subroutines and control program flow with loops and error handling. If you've been wishing for a batch program for Windows, WSH may be the answer.

Mike DeKoning
via the Internet

PC Although WSH comes on the Windows 98 CD-ROM, it's not always installed by default. If it's not installed on your system, launch the Add/Remove Programs applet from Control Panel and choose the Windows Setup page. Double-click Accessories, and scroll down to Windows Scripting Host in the resulting dialog. Check Windows Scripting Host, click OK, and click OK again to make WSH available on your system. Even if you do have WSH from the Windows 98 CD, you'll probably want to download the documentation from Microsoft's Windows Scripting Host page at <http://msdn.microsoft.com/scripting/windowshost>.

Most scripts for WSH aren't as simple as the DOS batch files they nominally replace, but this one is very straightforward. The single quote at the start of each of the first several lines tells the WSH to treat the line as a nonexecuting comment. It's generally a good idea to use comments in your scripts so you'll remember what they're for and how they work. The Option Explicit line means that every variable used in the script must be explicitly defined using a Dim statement. With this statement in place, if you misspell a variable name, perhaps MyFilename for MyFilename, you'll get an informative error message. Without it, the WSH will treat MyFilename as a brand-new variable, with unpredictable results. Always use Option Explicit!

Next, the script defines a WSHShell object and initializes it using a call to the WScript object's CreateObject method. The main WScript object is always available; other objects need to be created in this way. The WSHShell object provides information about and control over elements of the Windows shell, including the registry. The statement On Error Resume Next ensures that a runtime error (such as attempting to delete a nonexistent registry key) won't cause the script to halt.

The WSHShell object's RegDelete method can delete either a registry key or a registry value. Its single argument must begin with one of five standard root keys or their abbreviations: HKEY_CURRENT_USER (HKCU), HKEY_LOCAL_MACHINE (HKLM), HKEY_CLASSES_ROOT (HKCR), HKEY_USERS, or HKEY_CURRENT_CONFIG. To delete a value, you pass the key name followed by a backslash and the value name.

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To delete a key, as this script does, you pass the key name ending with a backslash.

The last line of the script is one I added. Using the `WSHShell` object's `Popup` method, it displays a message saying that the script worked. The first argument to the `Popup` method is the string to be displayed in the message box; the remaining arguments are optional. In this case, 60 represents the number of seconds to wait for a response before automatically closing the message box, and `Done` is the message box's caption. The last argument is calculated by adding two numbers, one that indicates which buttons should be displayed and one that identifies the desired icon. The button numbers are 0 (*OK*), 1 (*OK, Cancel*), 2 (*Abort, Retry, Ignore*), 3 (*Yes, No, Cancel*), 4 (*Yes, No*), and 5 (*Retry, Cancel*). The icon numbers are 16 (*Stop*), 32 (*Question*), 48 (*Exclamation*), and 64 (*Information*). This script uses 0 + 64, meaning the message box has an *OK* button and an *Information* icon.

As this little example shows, scripts for WSH don't have to be complex to be useful. You can carefully modify this script to delete a different registry key or value, if you wish, or experiment with the arguments to `WSHShell.Popup`. And if you devise a clever and widely useful script, be sure to tell us about it!—Neil J. Rubenking

Stripping Carriage Returns

I recently upgraded from Microsoft Windows 3 and Word 2.0 to Windows 95 and Word 97. In the process, I've lost the ability to run a macro I depend on to strip carriage returns. The macro is particularly useful for converting long e-mail messages with a return after every line. Is there a way to make the macro work in Word 97, or is an equivalent macro available for Word 97?

Jim McDonnell
via the Internet

PC You could easily create a macro for stripping returns by recording it. The macro you'd wind up with would be unnecessarily long, however, at over 40 lines. The following macro does the job in far fewer:

```
With ActiveDocument.Content.Find
    .ClearFormatting
    .Replacement.ClearFormatting
    .Execute Findtext:="^p^p",
    ReplaceWith:="@$$@",
    Replace:=wdReplaceAll
    .Execute Findtext:="^p",
    ReplaceWith:=" "
```



```
Replace:=wdReplaceAll
    .Execute Findtext:="@$$@",
    ReplaceWith:="^p^p",
    Replace:=wdReplaceAll
End With
```

(Note that the three `.Execute` lines should each be entered on a single line with the `.Replace` and `.ReplaceWith` lines that follow them.) It also serves as a model for search-and-replace operations that you might include in longer, more complex macros. I'll also use it to give a step-by-step description of how to create a macro from scratch. First, however, here's a look at how the macro works.

The macro's first line is a `With` statement:

```
With ActiveDocument.Content.Find
```

This tells the macro that until it gets to the `End With` statement, it will be working with the contents of the currently active document, using the `Find` object, which VBA uses for both search and replace operations.

The next line, `.ClearFormatting`, is equivalent to choosing *No Formatting* for the *Find What* text box when running a search-and-replace manually. Include this command whenever you run a search with a macro; it ensures you've cleared any format criteria left over from an earlier search, and it returns the criteria to a known state. The third line is

```
.Replacement.ClearFormatting
```

which serves the same purpose for the replacement format.

The next three lines do the actual work. Each executes a search-and-replace operation using the `Find` object as defined in the `With` line. Each uses `FindText` to define the text to find, `ReplaceWith` to define the replacement text, and the `Replace` setting `wdReplaceAll` to tell the macro to replace all occurrences that it finds.

The macro assumes that paragraphs are separated by two carriage returns. It searches for the two returns, represented by `^p^p`, and replaces them with `@$$@` to serve as a marker for the end of each paragraph. It then searches for all remaining carriage returns and replaces them with spaces, and it finishes by searching for the end-of-paragraph markers and replacing them with two carriage returns. I chose `@$$@` to mark the paragraph

ends because the four characters are not likely to show up together very often.

To create this macro, choose *Tools | Macro | Macros* to open the *Macros* dialog box. Enter an appropriate name (such as *CleanReturnsOut*) in the *Macro Names* text box, and choose *Create*. Word will launch the VBA Editor and start the macro entry with a few lines that take the form:

```
Sub CleanReturnsOut()
'
' CleanReturnsOut Macro
' Macro created 3/18/99 by David Stone
'
End Sub
```

The first line in this group marks the beginning of the subroutine that will become the macro. The last marks the end. The leading apostrophes on the second through fourth lines tell Word that these are comments rather than commands. The VBA Editor automatically adds these comments with the macro's name, the date, and the macro's author. When the editor opens, it leaves the cursor on the blank line just before the `End Sub` statement. You can then type the text. (Or you can paste it in if you've downloaded the PC Tech archive for this issue from www.pcmag.com/download. The macro is in the file *Clnret.doc*, which you'll find in the archive.)

If you type the text, you'll notice that the VBA Editor will pop up various help features at different times. I don't have the room to discuss them here, but you should take some time to examine them and see how they work. (If there is enough interest, I'll return to this subject in a future issue.) When you're done, choose *File | Save Normal* to save the macro to disk, then *File | Close and Return to Microsoft Word*. You should now test the macro on a file to make sure it works.—M. David Stone

Calculations on Date/Time Values

I download a file from our host system that shows times-of-service durations. As an example, a 2-hour duration is shown as *2:00*, and an hour and a half is shown as *1:30*. These show up in Microsoft Excel as time-of-day values, and I am unable to perform calculations such as spreading costs based on time consumed. How can I convert these time values to numeric values for calculations? With 45,000 lines of time data, I want to be able to convert the time values quickly.

Ronald D. Binder
Feeding Hills, Massachusetts



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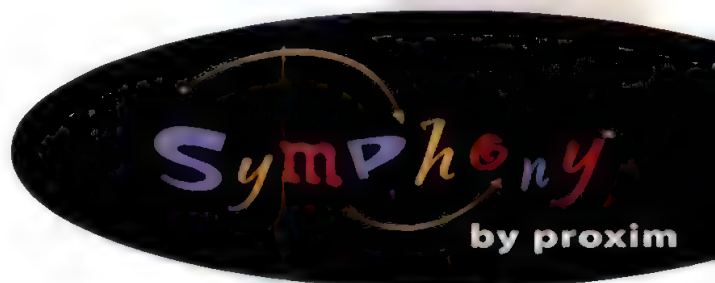
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PC Time values, regardless of how they are displayed, are stored as fractions of a day. Noon, for example, is stored as 0.5, 6:00 A.M. as 0.25, and so on. Because there are 1,440 minutes in a day, you can convert a time value to minutes by multiplying by 1,440. To convert to seconds, multiply by 86,400; to convert to hours, multiply by 24.

A simple way to convert a whole range of time values at once is to store the conversion factor in a separate cell. Copy that cell to the clipboard, select the range you want to convert, choose *Paste Special* from the *Edit* menu, and choose the *Multiply* option button in the *Paste Special* dialog box. After you perform this multiplication, you will probably have to assign the range a numeric or general format to get the results that you are looking for.

You can convert time values greater than 23:59 the same way you would convert time values that are 23:59 or less. A duration of 25 hours 39 minutes, for example, might appear on your spreadsheet as 25:39:00. Multiplying that by 1,440 and formatting as *General* yields 1,539, the number of minutes in 25 hours 39 minutes.

If you store a duration of less than 60 minutes without a leading 0, Excel will record a text value instead of a time value. Enter :30, for example, and you get the text value :30, not the time value 0:30. (You can tell it's a text value because Excel aligns it by default flush left.) If you try to convert this text value by multiplying by a numeric conversion factor, you'll get a #VALUE! error. You can get around this by manually editing the text value that lacks the 0, but if you have 45,000 lines to deal with, you will want a quicker method.

Here's a macro that converts all cells in a selection to minutes, taking into account the possibility of text values that need to be converted first to time values.

```
Function ElapsedHoursMinutes(interval As Variant) As String
    Dim totalhours As Long, totalminutes As Long, totalseconds As Long
    Dim days As Long, hours As Long, minutes As Long, seconds As Long
    days = Int(CSng(interval))
    totalhours = Int(CSng(interval * 24))
    totalminutes = Int(CSng(interval * 1440))
    totalseconds = Int(CSng(interval * 86400))
    hours = totalhours Mod 24
    minutes = totalminutes Mod 60
    seconds = totalseconds Mod 60
    If seconds > 30 Then minutes = minutes + 1 'round up
    ElapsedHoursMinutes = totalhours & ":" & Format(minutes, "00")
End Function
```

```
Sub TimeConvert()
    On Error Resume Next
    Const Hours = 24, Minutes = 1440,
    Seconds = 86400
    For Each cell In Selection
        If Left(cell.Value, 1) = ":" Then
            cell.Value = "0" & cell.Value
        End If
        cell.Value = cell.Value * Minutes
        cell.NumberFormat = "General"
    Next cell
End Sub
```

(Note: The line beginning *Const Hours* must be entered as a single line including *Seconds = 86400*.) The *On Error Resume Next* statement lets the macro skip gracefully over any cells it can't convert—text values that are not time values in disguise, for example.

As written, the macro converts time values to minutes and displays the results in general format. To convert to hours or seconds, change the line that begins *cell.Value*. To change the display format, modify the line that begins *cell.NumberFormat*. For example, write:

```
cell.NumberFormat="0.00"
```

to display the time value with two decimal places.—*Craig Stinson*

Summing Time Intervals

I'm trying to set up an Access database that will track total hours for students, but I can't get the program to accumulate hours beyond 24. We need to track up to 1,500 hours per student. I can set up the form to do the time-clock hours cal-

culations, but I need a way to accumulate the hours per student.

Frank C. Warner
Proctor, Arkansas

PC If you have two Date/Time fields, one named *StartTime* and one *EndTime*, you can obtain the time interval with the formula *[EndTime]-[StartTime]*. Appearances aside, Microsoft Access calculates the result correctly, even for periods longer than 24 hours. It just doesn't *display* the result correctly. The problem is that Access's built-in time formats are not designed to handle intervals greater than 24 hours. You can overcome this with a user-defined function that formats the value correctly. One such function is shown in Figure 2.

Internally Access stores Date/Time values as double-precision numbers, where the left side of the decimal represents the date and the right side represents the time stored as a fraction of a 24-hour day. Calculated time intervals are represented the same way, with a "number of days" portion on the left side of the decimal point and a "fraction of a day" remainder on the right side. When you display the value using a time format, however, you see the right side only.

Figure 2 shows the *ElapsedHoursMinutes* function. You pass the function a time interval and it returns a formatted string that represents the elapsed time in *hours:minutes* format—121:30, for example. Let's assume you have a students table with start times and end times. You can create a query that contains a column to calculate the student hours by typing the following calculated field into the Field cell in the design grid:

```
Hours: [EndTime]-[StartTime]
```

You can then use that query as the record source for a grouped report that sums the hours by student and displays the result using the *ElapsedHoursMinutes* function. In order to do this, you create a text box in the group footer of the report and place the following in the text box's Control Source property:

```
=ElapsedHoursMinutes(Sum([Hours]))
```

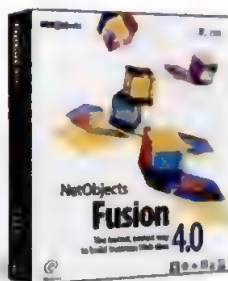
For more information on Date/Time values and their nuances, have a look at Microsoft Knowledge Base articles Q88657 and Q130514, available at <http://support.microsoft.com>. The *ElapsedHoursMinutes* function in Figure 2 is a modified version of one of the functions supplied by Microsoft in these articles.

—Sal Ricciardi **PC**

FIGURE 2. Use this function to convert a date/time interval into a string in hours:minutes format.



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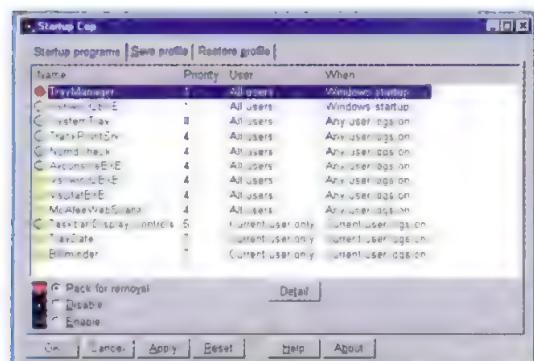
UTILITIES

Manage Your Start-Up Programs

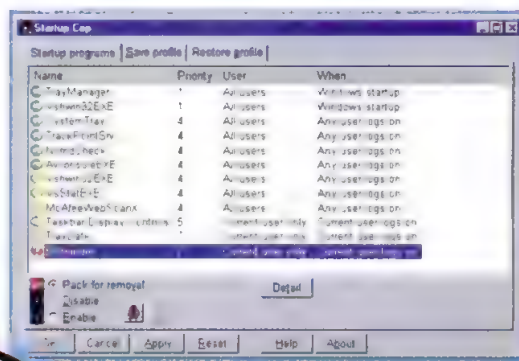
When Microsoft Windows starts up, it automatically launches a number of programs for you. Some of these come from the Startup folder. Windows also looks in six other locations for files that should be launched at start-up. Startup Cop helps you handle problems with programs that are automatically launched at start-up by listing them and letting you disable, enable, or delete them. You can save the list of currently enabled and disabled programs as a profile, which you can restore at a later time.

Startup Cop runs under Windows 95, Windows 98, Windows NT 4, and Windows NT 5 beta 2. An article about how to use Startup Cop and how it was written is available on our Web site at www.pcmag.com/utilities. A link to download the utility and its source code can also be found there.

Neil J. Rubenking, the author of Startup Cop, is a contributing technical editor of PC Magazine. Sheryl Canter is the editor of the Utilities column and a contributing editor of PC Magazine.

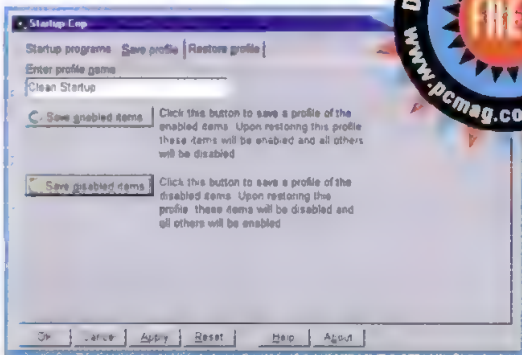


Startup Cop lists all the processes that are automatically launched when you start your computer, and it lets you enable, disable, or remove them.

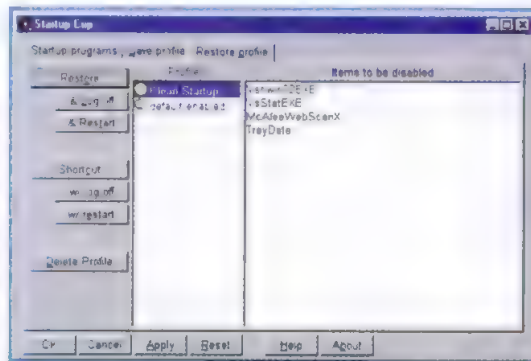


Before you can remove a start-up process, you must successfully reboot your computer. Startup Cop does not reveal the hidden skull-and-crossbones button used for deletion until after a successful reboot.

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Component Technology: Past and Future

By Peter Coffee

For more than a decade, enterprise IT architects have been promised a golden future based on software component technology. Following 1998's advent of Enterprise JavaBeans, CORBA 3.0-based products, and the first beta tests of Microsoft's COM+ technology, components may finally start to give high-level application designers a quantum boost in reusability of code and reliability of multitier operation.

Software components have come to market under many names: as objects, as VBX controls, as ActiveX and COM (or DCOM) modules, and as cyberspace citizens of the cosmopolitan CORBA. After a two-decade warm-up, it's reasonable for corporate buyers to ask, "Where's the beef?" Component proponents have tantalized IT decision makers with the prospect of substantial reductions in life-cycle software cost, but many buyers may feel that they have been trapped in an endless maze of technical demonstrations and pilot projects. It's time for the people who pay the IT bill to start getting returns on their component technology investment.

WHO SPENDS? WHO SAVES?

To ground our expectations for what enterprise IT can gain from component-based software, let's consider the benefits that have been promised at different times as component technology has evolved.

At one point, proponents argued that component-based software would lower the barriers to entry into the mass-market software marketplace. If a word processor, for example, were structured as a collection of components, then a small development company could enter the market with specific enhancements to the document preparation process. An entrepreneurial team could focus on a specific area of expertise, without the need to duplicate the entire core capability of a product such as Microsoft Word.

With this model of component software in mind, visionaries suggested that word processors, spreadsheets, and other end user applications would be extended in a manner deter-

mined by users' needs—rather than being tied to one or two large vendors' schedules for monolithic updates, such as the massive Word 97 (or the even more complex forthcoming Word 2000).

In practice, though, the potential for a flatter and more competitive market in general-purpose software was neutralized by other developments. Individual products such as word processors and spreadsheets were absorbed into multifunction suites, with extensive coupling between different applications.

While it was true that a single module might provide spell-checking capability for a word processor, a spreadsheet, and a presentation graphics tool, the interfaces that made this happen were obscure. Standard software worked well enough to discourage most users

from exploring third-party enhancements, which might create compatibility problems. New file formats propelled users forward on a continuing treadmill of upgrades to core applications, rather than letting them add new functions to a stable productivity platform.

THE ROAD TO WHERE WE ARE

Smalltalk	Though it brought object-oriented programming to corporate IT's attention, it lacked a network orientation
VBX controls	This 16-bit component technology for early versions of Microsoft Visual Basic popularized mass-market reusable components but lacked "true" objects' benefits of inheritance and specialization
COM/DCOM	This 32-bit architecture, which underlies Microsoft Office and Windows NT, is ill-suited to long-distance connections between heterogeneous platforms
CORBA	Conceived as a vendor-neutral architecture, CORBA was slowed by early competitive efforts to differentiate products but is gaining ground in partnership with the Enterprise JavaBeans component model
COM+	Microsoft's promised enhancement to DCOM adds software layers to emulate CORBA's strengths but is a victim of Windows NT 5.0 (now Windows 2000) delays; it is expected to favor Microsoft technologies

mined by users' needs—rather than being tied to one or two large vendors' schedules for monolithic updates, such as the massive Word 97 (or the even more complex forthcoming Word 2000).

Productivity gains, if any, accrued to the vendors of mass-market software rather than to the buyers. Even for vendors, however, it is far from certain that component techniques created significant opportunities for software reuse: Commercial PC applications pursued an evolutionary path that was twisted and kinked by competitive pressures, such as the sudden burst of demand for Web-enabled applications.

The first wave of components, therefore, delivered only a jigsaw-puzzle kind of modu-

WHAT HAPPENED NEXT?

In the mid 1990s, it seemed as if a new determination swept through the software development community: a collective will to make the reality of software components live up to the promise.

Electronic hardware, it has long been observed, is built from parts that eliminate the need to understand how internal functions are performed. A circuit designer can lay out a radio, for example, by choosing transistors (or multitransistor integrated circuits) from data sheets without needing a knowledge of how a part's behaviors are achieved. Many theorists have urged that software should hold itself up to this standard.

The Internet and the World Wide Web made the goal of standard components seem much less abstract. Suddenly, there actually was an information-processing environment

in which it was useful to generate information, or to describe an information-transforming process, in a format that could be understood and used on many different platforms.

The culture of the Web, initially a somewhat academic and communal set of ideals, migrated quickly into commercial settings. Corporate IT buyers, often guided by Webmasters of somewhat libertarian leanings, demanded that vendors deliver platform-neutral solutions. Buyers sought enterprise software that made effective use of commodity-priced processing power on standards-based networks.

The advent of the Web, and its rapid rise to corporate credibility, created a favorable environment for talking in practical terms about software component technologies. There were

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strong motives for finding ways to let the different parts of an application do their jobs in the most convenient places. It was genuinely useful and no longer merely elegant to place functions close to related data—to have the smallest possible number of bits crossing costly long-distance connections.

When people actually tried to get work done with early versions of software component technology, many gaps emerged between promise and practice. A multivendor specification, such as the Common Object Request Broker Architecture, might define a basic framework for building an object request broker (an ORB) that would let one node on a network seek data or services from another. In all too many cases, however, buyers found that each vendor had made its ORB “better” in some key way than its competitors’ products. This differentiation had predictable results: Only the most rudimentary functions were actually vendor-neutral, and cross-vendor operation lacked the performance and scalability demanded for enterprise applications.

The Visigenic implementation of the CORBA specification served as something of a kernel for consolidation of the market. When Novell and Oracle licensed the company’s VisiBroker, they crowned the product with the status of a reference implementation. Iona Technologies’ Orbix implementation achieved a similar role, much as PC compatibility was once defined by the Texas Trio of Tandy, Dell, and Compaq.

IBM, Inprise (which acquired Visigenic), and Symantec all put their weight behind an enterprise software model based on CORBA. Regardless of their internal technologies, software components in a CORBA-based space would communicate with each other to cooperate in performing high-level tasks. No component would need to know the platform on which another component was doing its part of the job.

No one who knows the enterprise software marketplace will be surprised by what happened next.

PROMISES VS. PRODUCTS

When Iona Technologies’ Annrai O’Toole speaks of CORBA’s prospects, he becomes almost evangelical. “Object request brokers will be everywhere, from your dishwasher to your mobile phone,” he has predicted. Note,

however, that he uses the future tense.

The distinctive selling proposition of PC standards-setters has always been that something imperfect today is better than something better at an undefined future date. The triumphs of Intel’s x86 over Motorola’s 680x0 and of Windows 3.x over IBM’s 32-bit OS/2, as well as other key victories, have been driven by users’ preference for using the tools on hand instead of waiting for more elegant solutions.

Microsoft brought the “bird in the hand” dynamic into the battle over who would define the rules of component computing. “These CORBA guys had their shot” is the opinion of Microsoft’s James Utzschneider. He continues, “They were never able to deliver their component integration story in a cost-effective manner.”

Microsoft, of course, argues that its own solution—the Distributed Component Object Model, or DCOM—was both delivered and proved cost-effective in the mid 1990s. Microsoft’s follow-on, COM+, is promised in the same time frame—the late ’90s—as the competing Enterprise JavaBeans (and also promises backward compatibility with developers’ DCOM investments). Thus are the battle lines drawn.

WHO’S ON THE FIELD?

At the start of a pro sports event, the players come onto the field while their personal statistics come up on the stadium’s scoreboard. Let’s go through this process with the players who contend on the field of distributed components.

Lined up and ready to play are the forces of Microsoft’s DCOM, a component model that some have called “COM with a longer wire.” This appellation refers to Microsoft’s original Component Object Model, conceived as a way for the pieces of an application on a single PC to communicate through standard interface protocols.

It is COM that lets an embedded Excel spreadsheet, for example, summon up the Excel menus when that spreadsheet object is edited in-place within a Word document or a PowerPoint presentation chart. DCOM allows COM entities to communicate across the universe of a network, as easily as they do within the single constellation of tasks on a Windows PC.

The catch, however, is that DCOM plays a running game: A DCOM object exists only as long as at least one process maintains a reference to that object. This model is not entirely suited to widely separated network nodes running many different tasks over communication links that may not be perfectly reliable.

Microsoft’s COM+, currently existing only

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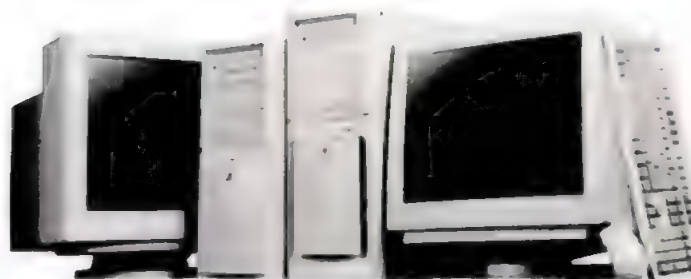
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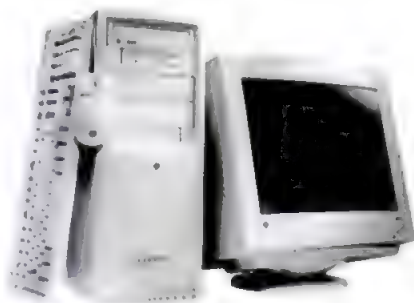
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ENTERPRISE COMPUTING

in the form of a technology preview, adds a runtime environment that loosens DCOM's tight coupling between specific events and their receivers. Managed by the COM+ runtime, more than one receiver could await a particular event, with each receiver performing different actions in response to a single triggering condition.

Meanwhile, in a huddle and eager to take possession of the ball is the all-star team of CORBA. The members of that team may not train together, but they share a common playbook and they're used to the long game. CORBA, unlike DCOM, was conceived for geographically dispersed networks handling many different tasks on many different time scales. A CORBA object retains its identity even if swapped out from memory to persistent storage, such as a disk file. It is possible to test the equivalence of two different references to what may be a single CORBA object: An object's identity persists, whether or not that object is currently the focus of any active process.

CORBA 3.0 improves the integration between Java modules and native-code

ActiveX components can quickly become a Windows-on-Intel (or "Wintel") environment. Because ActiveX components execute directly on the processor of an Internet client PC, they can do anything that the PC's user is allowed to do.

On a completely insecure operating system such as Windows, the open-ended privileges of ActiveX allow a downloaded component to do anything at all, making the viewing of active network content a high-risk proposition.

JavaBeans components are intermediate Java byte codes, executed by a Java Virtual Machine as implemented on the client software/hardware platform. Unlike ActiveX code, JavaBeans are in no way specific to any operating system or processor architecture: It is the job of the Java Virtual Machine to translate platform-neutral byte code into the local hardware's corresponding native instructions.

WHAT YOU GET VS. WHAT YOU GIVE

ActiveX/DCOM	Windows native code. This technology is fast but inherently insecure, because network-resident modules gain users' privileges when downloaded to client machines.
JavaBeans	Java byte code. JavaBeans is gaining speed with enhanced runtime compilation tools, but it is generally less able to exploit specific features of any single platform. It permits better control of execution privileges because of intrinsic Java security features, which are now more accessible thanks to the policy-based model in the new Java 2 specification.

components, and it vies with Microsoft Transaction Server in promising transparent integration of transaction protocols into objects' interactions.

COMPONENTS IN PLAY

When the ball gets snapped on the component playing field, who makes the play? In a DCOM space, the handler is likely to be an ActiveX component; in a CORBA space, the handler is likely to be an instance of a JavaBeans class.

ActiveX components were created by Microsoft when the company needed to slim down its unwieldy OLE (Object Linking and Embedding) technology. Designed for the generous communication bandwidth of in-memory communication, OLE carried overhead (such as the memory structures needed to define an on-screen window) that was not always needed and whose burden was unacceptable on bandwidth-limited Internet connections.

ActiveX components are made up of binary code that's specific to a particular processor, meaning that an Internet populated by

The resulting indirection makes it possible for developers to limit a remote component's privileges.

Many people erroneously believe that Java security is an all-or-nothing proposition, having seen only Java applications (which have no security limits) and Java applets (which place stringent limits on high-risk activities such as access to the client machine's local files). Actually, Java security is extremely fine-grained: For example, a particular Java environment might let imported code open only files whose names begin with the letter G.

There is a large vocabulary of `check()` methods that a Java developer can tailor to a particular situation, defining in detail exactly what will be permitted. With their precise control of the privileges available to active network content, JavaBeans components are intrinsically less worrisome to a network administrator than ActiveX controls.

The security model for ActiveX is based on cryptographic signing, which tells you whom you can sue if rogue ActiveX components damage your local resources. The security model for JavaBeans can prevent such

damage from taking place, and it can trigger a warning that a malicious action has been attempted.

A BUYERS' MARKET

Contrary to Microsoft's pronouncements of a few years ago, CORBA will not be eclipsed by DCOM or even COM+. The Microsoft COM+ technology is closely coupled to the much-delayed Windows 2000 (formerly known as Windows NT 5.0), meaning that COM+ cannot become pervasive until mid-2000 at the earliest, as enterprise managers deal with Y2K problems before rolling out a major operating-system upgrade. Unix vendors are already delivering 64-bit operating systems, just in time to manage large object collections such as those associated with rich-media databases, meaning that CORBA's interoperability will remain an important asset.

In the electronic commerce environment, it's vital for users to feel secure in their use of downloaded active content. Consumers may be willing to tolerate the brand-name assurance of cryptographic signing, but business-to-business e-commerce will be more inclined to demand the more rigorous security of Java and therefore to employ an Enterprise JavaBeans framework that's built on a CORBA foundation.

Both camps will claim "interoperability," but Microsoft's notion of interoperability involves publishing API's to let developers create platform-specific components that communicate with each other on different platforms. JavaBeans portability lets a single piece of byte code move from one platform to another and execute wherever it comes to rest. Different architectures may favor the performance benefits of the former approach or the dynamic flexibility of the latter.

Microsoft promises to offer bridges from DCOM and COM+ to CORBA; CORBA vendors are forced by the prevalence of Windows on the desktop to offer bridges to that COM-based environment. The result is a good news/bad news joke, of sorts. The good news is that there is no wrong choice, and that developers can use whichever model is better supported by their familiar tools and their currently favored platforms. The bad news is that corporate IT architects will need to stay abreast of both of these models if they are to reap the full benefits of component-based design. **PC**

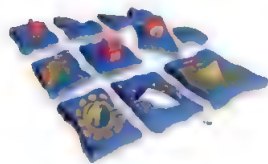
Peter Coffee is the advanced technologies analyst for PC Week Labs. His books include Peter Coffee Teaches PCs and How to Program Java. His weekly column, PC at Work, addresses issues of personal and departmental computing.

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Storage in Your Networked World

Hardware: Server, Tape and Network

**Storage Management: Tape-Based, On-line
and Hierarchical Systems**

**Plus: How to Buy Network Storage and
the Future of Network Storage**

NEW FROM THE EDITORS OF
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STORAGE

By Frank J. Derfler, Jr.

Network storage isn't just about servers anymore. Storage is now a separate network entity with its own architecture, management, and investment strategies. While it's easy to add a few more gigabytes into a server, the easy way might not be the best way for your business. Strategies like high reliability storage, distributed storage, and hierarchical storage management replace brute force methods with finesse.

There are a blizzard of acronyms, specifications, and performance measures you'll have to find your way through to figure out your storage options. But it's worth the effort. New storage services, systems, and technologies mean less work for IS managers, and faster recovery from problems. We'll define the acronyms, guide you through the specifications, and survey storage strategies to help you find the best alternatives for your business and network.

The need for more network storage capacity is like a steady uphill climb, but the need for better storage reliability is like scaling a steep cliff. Lack of attention to storage reliability can lead to a fatal fall. Reliability has two levels, immediate and restoral, and you pay for what you get at each level. Immediate reliability insures that your network storage systems keep working. When you measure revenue by the minute in your business, it's worth paying for this immediate reliability. Restoral provides a graceful way to get back into operation if the storage systems fail. Restoring data is the other side of backup. Everyone talks about data backup, but restoring it is the thing that really matters.

Typically, you get immediate reliability through redundancy. If one drive, power supply, or adapter card fails, it's nice to have another ready to immediately pick up the slack. Today's RAID (see "Words and Terms You Need to Know") storage systems often sit outside the server and can even connect to more than one server in order to keep network storage available. However, adding a RAID sub-system can double the cost of a server and there are decisions you have to make about the cost and the benefits.

In our analysis, the backup and restoral process comes down to two elements: the media and the software. Despite advances in CD technology, nothing has really replaced tape for economical storage. However, even tape media decisions involve balancing cost, capacity, and speed. Competitive backup and restoral software products have been proven by time and offer a variety of features.

Tape storage isn't perfect for every circumstance. Sometimes users or devices are separated from the LAN and central storage device. In these cases, you can dispatch your data across the Internet or across a private wide area network to an on-line storage facility or to your own storage system.

Storage in a specialized facility is about as safe as you can get. Companies like @Backup, Atrieva, Connected, and Intel have established high security facilities to hold and protect your data. The monthly fees are reasonable and preclude the upfront costs of equipment investment. The drawback is that your Internet connection is probably much slower than a local tape

storage system. So-called "delta" transfer technologies, which back up only changed data, help to reduce the communications load. But applications such as sophisticated relational database programs change many files with each entry. However, if you can give your backups a little time to execute, then on-line systems offer unprecedented security and convenience.

In the mainframe computer era, computer centers practiced central storage and central control. Today's storage equipment allows for decentralized storage with centralized control, but the sophisticated lessons about backup operations learned in mainframe systems have re-emerged in today's storage management software. Proven features such as centralized scheduling, partial backups and updates, and sophisticated management reports combine with new cross-processor and cross-operating system capabilities in powerful software packages.

Network software buying decisions often center on your existing management architecture and the specific capabilities you need for your operating systems and hardware. Of course, browser-based management is the latest thing. But products such as Seagate Backup, Computer Associates Cheyenne ARCserve, and Stac Replica are proven network performers. They've been around for years, and their sophisticated management capabilities are still the best.

Distribution Centers

If your storage is in a RAID subsystem attached by a SCSI cable, then it still relies on the server for its own successful operation. But two new sophisticated architectures provide distributing storage independently on the network. Network attached storage (NAS) and storage area networks (SAN) are two alphabet soup concepts for separating storage from direct server attachment. Improved

This edition of ZD Tech Brief is from the editors and writers of PC Magazine, PC Week, and Sm@rt Reseller. It's designed to provide overviews of computing strategies, technologies, and trends. For more on network storage news, products, and market trends, visit PC Magazine online at www.pcmag.com, PC Week at www.pcweek.com, and Sm@rt Reseller at www.smartreseller.com. Frank J. Derfler, Jr. is the Senior Networking Editor of PC Magazine; Steve Rigney is a Contributing Editor to PC Magazine; Stephanie Wilkinson is a frequent contributor to PC Week; and Alan Zeichick is a Contributing Editor to Sm@rt Reseller.

TEXT CONTINUED ON PAGE S7

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Every year, the amount of data you store doubles.

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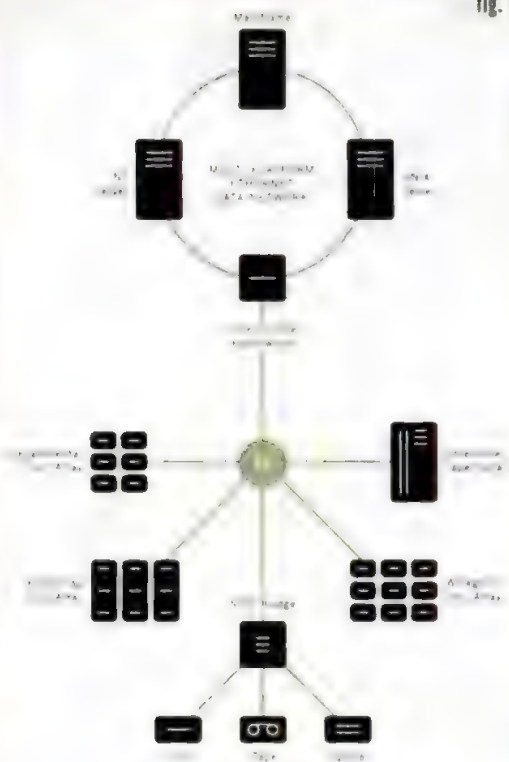


The background of the advertisement is a complex, abstract composition. It features a dense field of binary digits (0s and 1s) in various sizes and orientations, creating a sense of digital data. Overlaid on this are several thick, dark diagonal lines that sweep across the frame from the top-left towards the bottom-right. The overall color palette is a mix of light and dark tones, with the binary code appearing in a light, almost white, color against a darker, textured background.

If you use the Internet, it
doubles every six months.

**NOW MIGHT BE A GOOD
TIME TO TALK** about
revolutionary new ways
to store information.

fig. 1



STORAGE NETWORKING

[illegible]

A STRATEGIC LOOK

STRATEGIC LOOK

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reliability and easier expansion are the goals of both strategies. But that's the only similarity they share. Putting NAS in place is something you can decide to do and make happen in an afternoon. A SAN requires investing in a new kind of infrastructure.

The concept behind network attached storage devices is simple. The NAS device is a kind of thin server that adds gigabytes of highly reliable storage at a reasonable price with little setup. You purchase a turnkey NAS device, which is often smaller than a desktop PC, and click it into a LAN cable going to your network hub. Network attached storage increases network traffic, although Ethernet switches can effectively segment the network and reduce contention. And it creates a more complex administrative environment.

Storage attached networks also separate storage from the file servers, but they use a much faster device connection than your LAN. The SAN is linked using a networking standard called Fibre Channel. A Fibre Channel Arbitrated Loop (FCAL) moves data at 1 gigabit-per-second over distances as great as 10 kilometers. Such capabilities allow you to configure centralized storage systems where they're physically safe and easily managed. However, real SAN products are just emerging, and the cost of Fibre Channel will confine the SAN architecture to enterprises that really value high reliability.

Managing Files and Mail

You simply can't afford to dump your corporate e-mail and database files. Someday, you might need them to challenge a patent or to answer a court order. Despite the decline in the price of hard disk drives, it isn't economical to keep all old files in fast storage. Deciding which files to move to economical, permanent storage requires some sophisticated decision making. The solution for long-term data storage is called hierarchical storage management (HSM). The hardware end of an HSM system is covered by a variety of storage options. But the software side has some very specific requirements. It first needs to be able to move files into compressed, long-term storage based on their use. More importantly, it needs to find and retrieve the archived

files whenever you need them. The realities of legal and social pressures in business make HSM an important part of your enterprise storage architecture.

On the bottom line, managing the

way you store data can be critical to your business. You have many options and on the following pages, we'll provide you with some buying tips and things to consider as you organize your storage architecture.



Many network administrators go to great pains to insure that their data is copied to a tape every night. They also make sure to keep the tape safe from disasters and sabotage. Unfortunately, these network administrators don't always put the same effort into designing and maintaining the primary storage system. If they did, they would seldom, if ever, need to restore data from those tapes. While closely securing and protecting the data on your servers doesn't negate the need for a backup solution, it's your first line of defense.

What's the solution? A Redundant Array of Independent Disks (RAID) system in your servers is the most common, and currently the best, way to protect your network content. An investment in a RAID subsystem, typically

starting at over \$10,000, pays dividends by keeping your applications and data available to network users.

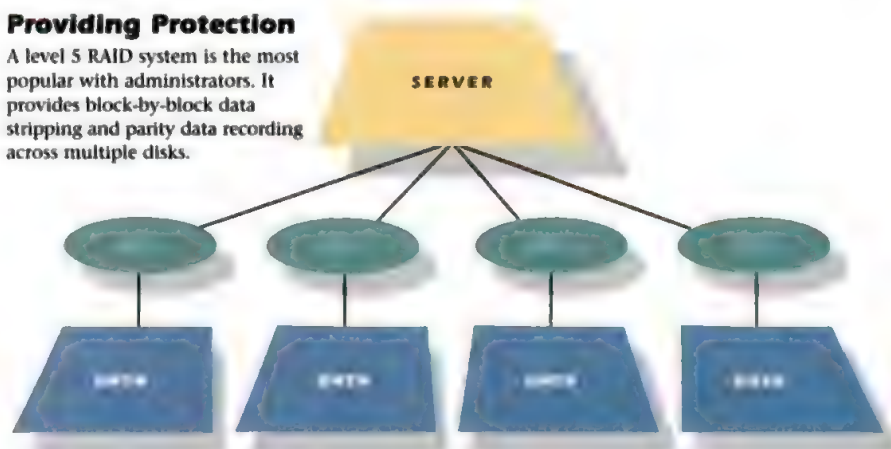
After its introduction in 1987, RAID became a popular network storage solution. Today you'll find it, in some form, wherever networks need high reliability. And vendors, such as Artecon/Storage Dimensions, Compaq Computer Corporation, Dynamic Network Factory, and Optima Technology Corporation, provide RAID systems to meet any network need.

RAID relies on a series of configurations, called levels, to determine how the drives connect and how data is written and retrieved from the disks. While there are six formal RAID, levels 0 through 5, many vendors offer proprietary RAID configurations with level

TEXT CONTINUED ON PAGE 58

Providing Protection

A level 5 RAID system is the most popular with administrators. It provides block-by-block data stripping and parity data recording across multiple disks.



numbers such as 7, 10, and 35. These additional RAID levels are gaining popularity, but most network administrators use common RAID configurations — levels 0, 1, 3, and 5. Each level has different costs and provides different performance and protection features. Here's what you need to know.

Level 0

RAID 0 systems don't provide any data redundancy. Their primary benefit is extra data capacity without complexity. Level 0 systems spread data across all of the drives in your RAID system. You must have at least two drives for level 0, but you can also span as many drives as your SCSI bus will allow.

A software version of RAID 0 is available in NetWare and Windows NT and network administrators have been using it to stripe or span data across multiple drives for years. While RAID 0 systems serve up data quickly, if one drive in the array fails, the entire system goes down.

Level 1

RAID 1 provides enough data redundancy to guard against many kinds of system failures. This RAID level uses disk mirroring to make an exact copy of data from one drive to another drive. If one drive fails, the other will take over with no obvious degradation in system performance.

The advantage of a level 1 is that it's the most redundant RAID level available. The disadvantage is its costs. Standard disk mirroring requires two times the number of drives in your system, and three-way mirroring requires three times the number of drives. Even with the low cost of big drives, disk mirroring is only feasible for the most important data.

Level 3

RAID 3 uses parity, or error correcting information, to quickly rebuild a failed drive. Level 3 requires one dedicated disk in the array to hold the parity information. The server's data is stripped across the remaining drives, usually a byte at a time. Meanwhile, the parity

drive keeps track of all of the information on the stripped drive, using it to restore the information if a drive fails.

Level 3 is fairly expensive because it requires an entire drive to be dedicated to parity. But it's a good choice for applications that write and read large chunks of data.

Level 5

RAID 5 also relies on parity information to provide redundancy and fault tolerance. Unlike RAID 3, this level uses data stripping to spread the parity information across all of the drives in the array. This makes level 5 one of the most fault-tolerant RAID levels available. It's also one to the most inexpensive, even though it's standard practice to use 4 or 5 drives in the array. RAID 5 is best on networks where there are many small file transfers from applications such as databases and spreadsheets. This is because it writes data in blocks rather than bytes like RAID 3.

RAID vendors all adhere to the level rules, but they often differ in how their products connect to and work with the servers. While there is some level of RAID functionality in most network operating systems, we don't recommend that you use it for mission-critical data and high traffic servers. If you use the RAID features built into the OS, the server's CPU has to perform all of the disk array functions for every read and write request. Because of this, you should invest in a hardware-based array controller. These adapters almost always have their own CPU. And in many cases they have RAM for caching disk inputs and outputs.

RAID Control

There are two types of hardware-based RAID array controllers: host-based and SCSI-to-SCSI. The host-based solution places the RAID controller inside the server, while the SCSI-to-SCSI solution uses an array controller located in the external disk subsystem. Naturally, each of these solutions has pros and cons.

The big advantage of a host-based solution is its performance. Because the controller is in the server it can transfer

data at bus speeds. The major drawback to the host solution is the need for a special driver for your network OS. Fortunately, most host-based RAID vendors, including Artecon and Compaq, provide drivers for NT, NetWare, and UNIX. But another drawback to host-based systems is their limited scalability. Since the server-based controller connects directly to the drives, you are limited to 7 or 15 drives for each controller. This is because each drive uses a SCSI ID on the controller, and most controllers are limited to either 7 or 15 IDs.

SCSI-to-SCSI subsystems attach to existing SCSI adapters in the server. This allows you to use any SCSI adapter the network OS recognizes to connect multiple subsystems to a single SCSI controller. Its advantage over a host-based system is that the server's SCSI controller uses a single ID for each subsystem, rather than an ID for each drive.

Hot Swaps

If your business sees lost seconds as lost dollars, then it's smart to make high reliability investments. Such investments include buying multiple CPUs and error-correcting memory for your servers. But the most critical investment is hard disk drives — the components most likely to fail. The good news is, you can live through a hard drive crash if you have a good RAID storage subsystem.

Almost every RAID system on the market offers hot-swappable drive bays. Such systems allow you to replace a failed drive without shutting down the network. And you should make sure the systems come with other redundant hardware, such as power supplies and cooling fans. This way you'll have access to the data with almost any failure you can imagine.

Even though RAID is your first and best defense against losing data, it's only one weapon in your network defense arsenal. To maintain a high level of reliable network data storage and management readiness, you have to make backups of your data and store them in a safe place. And whenever you have the chance to take your server down, test your fault-tolerant RAID systems and your backup systems.



By Steve Rigney

Spinning disk drives are merely electromagnetic devices, and like all moving mechanical things they break. Because of this fact, it's smart to operate on the assumption that your server's storage system will fail sooner rather than later. That's why a tape backup device becomes the last and one of the best lines of defense against data loss.

When you go shopping for a tape backup device, you'll find the costs, capacities, and performance measures vary. All tapes drives are not created equal, even if they appear to have similar features. And picking the right backup tape device for your network and storage needs is as important as choosing a hard drive and RAID system for your server. Let's look at the value end of the market first.

Old School

Travan technology devices have been around for years. They are derived from the quarter-inch cartridge (QIC) format. Imation Corp. developed the Travan format to increase the storage capacity on QIC devices for desktop and small network backups. In fact, most new QIC devices use tape that is really 0.315 inches wide, not the original 0.25-inch standard. Even so, Travan tape devices come in different flavors, including TR2, TR3, TR4, and the newest Network Series (NS) products. All Travan devices use the same 0.315-inch tape, and newer models simply increase the length in order to add storage capacity. For instance, a common 0.315-inch TR2 tape is 400 feet long and can hold approximately 2GBs of uncompressed data. Similarly, a TR4 tape is 740 feet long and can hold 4GBs of uncompressed data, and so on. Most standard TR models have a sustained uncompressed transfer rate of 600KBps.

As a solution for high capacity and performance network storage, Imation developed the NS specification. NS adds internal hardware compression and uses a technique called read-while-write verify with the standard TR format. With the added hardware compression,

NS devices increase the 10GB uncompressed data capacity of a cartridge to 20GBs of storage. That's why they are labeled NS20. The *read-while-write verify* technology also increases the device's network performance. Current NS20 devices have an uncompressed sustained transfer rate of around 970KBps. While NS20 devices are new to the market within the past year, they are available from several vendors including AIWA, Seagate, and Tecmar.

NS20 devices offer enough storage for most small businesses and the drives cost around \$600 for an internal model. However, the \$50 or so you'll pay for the blank cartridges is more expensive than the media for higher-capacity Digital Audio Tape (DAT) devices. Because of this, it's adequate for small networks and workgroups only.

Going Digital

The tape storage workhorse for small to medium networks is the DAT backup device. The DAT format has been around for a while and has been broken down into smaller specifications known as Digital Data Storage (DDS). There are currently three DDS specifications in use: DDS-1, DDS-2, and DDS-3. All DDS backup drives use a small 4mm cartridge, and the only difference is the length of the media. For example DDS-1 drives use a 60-meter cartridge compared to a 125-meter tape for DDS-3.

The internal hardware compression on such devices can squeeze up to 24GBs of data on a single DDS-3 tape. DDS-3 drives also provide a sustained transfer rate of around 3MBps compressed and 1.5MBps uncompressed. There's a price for the higher

TEXT CONTINUED ON PAGE S12

TAPE STORAGE AT A GLANCE			
DEVICE	TRAVAN NS 20	DAT DDS	AIT/ELT/MAX/MOT
APPROXIMATE COSTS			
Media	\$50	120	AIT: \$100; DAT: \$100; ELT: \$100; MAX: \$100; MOT: \$100
CAPACITY			
Uncompressed	10GB	14GB	AIT: 5GB; ELT: 4GB; MAX: 4GB; MOT: 4GB
Compressed	20GB	28GB	AIT: 10GB; ELT: 8GB; MAX: 8GB; MOT: 8GB
TRANSFER RATE	SLOW	GOOD	FAST
PROS	Inexpensive solution which works with all client PCs, most servers, and major backup programs	Uses inexpensive media and works with most NOSs and backup software applications	High capacity, high sustained transfer rates, and works with most major backup programs
CONS	Expensive media that provides 20GB maximum compressed storage	Expensive drives with only 4GB more maximum storage than Travan	Expensive drives

IF ALL DISC DRIVES WHY DO ALL TOP 10 CHOOSE SEAGATE?

FYI

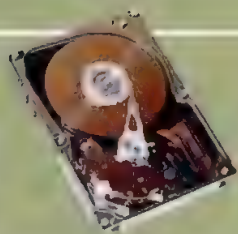
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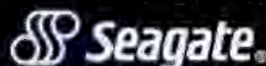
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Ultra SCSI (9LP) Ultra2 SCSI Fibre Channel	Ultra SCSI (18) Ultra2 SCSI Fibre Channel	Ultra2 SCSI Fibre Channel	Ultra2 SCSI Fibre Channel
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capacity and performance, though. DDS-3 drives sell for approximately \$1,500.

DDS drives are far more versatile than Travan devices. All DDS-3 drives are SCSI devices, and they will work with nearly any backup program on the market. These include Computer Associates ARCserve, Legato NetWorker, Seagate Backup, and Stac Replica. Because of this, DAT devices are a good backup solution for any small to mid-sized network running Windows NT or Novell NetWare.

Big, Fast Fixes

While DAT is fast becoming the most common solution for network backup storage, some administrators need to quickly backup more than 24GBs without changing media. This is where some of the most interesting (and expensive) tape backup technology comes into play. Sony's Advanced Intelligent Tape (AIT), Quantum's Digital Linear Tape (DLT), and Exabyte's Mammoth 8mm devices can all hold more than 20GBs of uncompressed data. They also provide higher sustained transfer rates than either Travan or DAT devices.

The AIT specification was developed by Sony and resold in Seagate drives. The current AIT specification allows for storing 25GBs of uncompressed data on a single cartridge. To increase capacity, AIT devices use a unique 2:1 ALDC (Adaptive Lossless Data Compression)

compression scheme that allows a single cartridge to hold up to 65GBs of data. This capacity is similar to Digital Linear Tape, but ALDC compression also improves the sustained transfer rates for AIT devices. The normal uncompressed transfer rate is 3MBps, but ALDC compressed boosts transfer rates up to 7.8MBps.

AIT devices use the same *helical scan* method to write data to tape as Exabyte's Mammoth tape backup drive. Unlike the linear serpentine method, used by DLT devices, helical scan writes data tracks at an angle to the tape media. This angled position stores more information in the same amount of tape space. AIT drives sell for \$3,000 to \$4,000 or about the same price as a 40GB DLT-4000 drive.

DLT drives are manufactured by Quantum, but sold by such vendors as HP, ASP, ADIC, and Procomm. There are two DLT specifications, DLT-4000 and DLT-7000. The major difference is the data capacity of each. The DLT-4000 drive can store 20GBs of uncompressed data and 40GBs using the Digital Lempel-Ziv (DLZ) hardware compression technology. DLT-7000 drives also use hardware-based DLZ compression, but it has an uncompressed data capacity of 35GBs and a 70GB compressed capacity.

The DLT-7000 is able to hold more data than the DLT-4000 because of the way it writes the information to the tape. Both models

use a linear serpentine technique to write the data on the tape. The newer 7000 drive uses a modified linear serpentine method called Symmetrical Phase Recording (SPR). In a nutshell, SPR rotates the head assembly in three different positions, which allows it to write data on the tape in a more condensed herringbone-type pattern. DLT drives also offer some of the highest sustained data rates. The DLT-4000 provides 1.5 to 3MBps, and the DLT-7000 delivers 5 to 10MBps. You can expect to pay around \$4,000 for a DLT-4000 drive and around \$8,000 for a DLT-7000.

The Mammoth is the latest version of the Exabyte 8mm drive and can store 20GBs of uncompressed data or 40GBs of compressed data on a single cartridge. Like the DLT drives, the Mammoth provides a 2:1 compression ratio, but it relies on IBM's Improved Data Recording Capacity (IDRC) compression algorithm rather than DLZ. In terms of speed, the Mammoth is rated to provide a sustained uncompressed data rate of 3MBps and 6MBps compressed. You can expect to pay about \$4,000 for it.

As you can see, capacity, price, and speed vary among these tape backup devices, but this product category is loaded with options. The thing to keep in mind is that tape backup is an extremely convenient and secure media for protecting your network data from damage or loss.

NetServer

plug and play

By Stephanie Wilkinson

Before their big drills ever hit the earth, Anadarko Petroleum Corp.'s geoscientists mine volumes of seismic data on drilling sites. Sophisticated two- and three-dimensional mapping programs help the Houston-based company locate untapped pockets of oil, allowing the company to make every dig count. But the data files created by those programs exact a price:

their enormous size can throw traditional network file servers off kilter.

The solution for Anadarko: a network-attached storage (NAS) server from Auspex Systems Inc. of Santa Clara, Calif. As a plug-and-play, platform-independent machine, the NetServer/7000 provides massive online storage capacity and high-speed input/output to Anadarko's teams of scientists.

"Instead of babying a server that's constantly on its knees, we now have the ability to efficiently service a large amount of data and a large number of clients with a very small staff," said Rick Stuart, system advisor at Anadarko.

Network AS is an increasingly popular option with IT managers struggling to keep up with massive data growth. These devices,

which remove data storage tasks from traditional servers onto physically separate boxes, can be easily plugged into a network where needed. They are nearly infinitely scalable, they centralize data for ease of management, and they can serve data to clients of varying operating systems and platforms.

Despite these advantages, the market for NAS devices is still in its adolescence. According to market research from Dataquest Inc., the NAS market is set to swell from \$900 million in revenue in 1998 to \$10.5 billion by 2002. In addition, the number of vendors in the market is expected to double in that time period, said James Staten, senior analyst at Dataquest in San Jose., as consumers become educated on the benefits of NAS.

"Right now NAS is employed mainly in large data centers," Staten said. "But word is starting to get out that it's a viable choice for smaller environments, like small businesses, branch offices and workgroups."

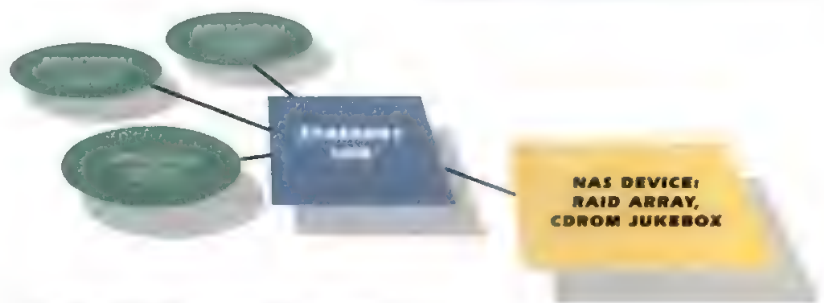
Size Matters

NAS devices range in size from 6 to 12 gigabytes (GB) on the low end, up to 4 terabytes on the high end. Costs range from \$1,000 to \$1.4 million. The high-end market is dominated by two vendors from Santa Clara, Calif.: Auspex Systems Inc. and Network Appliance Inc. At the low end are such vendors as Meridian Data Inc., Scotts Valley, Calif., and Procomm Technology Inc., of Irvine, Calif.

Overall, NAS stacks up well against other storage options, said Staten. Inside storage — storage found on a server's hard disk — has limited scalability, for instance. RAID systems provide larger storage capacities, yet are limited to homogeneous environments. Network attached storage, on the other hand, can be scaled infinitely, he said, by simply "snapping on" more NAS devices. Their multi-protocol functionality allows cross-platform data access. This saves money by reducing the need for many independent repositories of data and reducing the manpower needed to manage that data.

Indeed, other storage options couldn't

make the grade at Anadarko, where four Sun Microsystems Inc. SMP servers were being called on to store and process the enormous seismic data files. The servers,



Network Attached Storage

devices connect like any other node to the network.

Their high-capacity storage and protocol independence allow users across the network to share data access, and they require little maintenance.

with a collective disk-storage capacity of 200 gigabytes, were regularly ground down by the constant demands of 60 geoscientists transferring files around. In addition, accessing older files from the company's tape archive took a full 24 hours.

"If you spread disk capacity out far enough to give fast access to tons of data, the system becomes very complex and it's hard to find anything in particular," said Stuart. "But if you put all the data in one place, the whole system slows down. We had to look for a system that would not only centralize data but also provide extremely high performance — something philosophically different from the other solutions we'd seen."

Net Advantage

As an example of a "thin-server" solution, NAS devices can often speed up network performance by off-loading file handling tasks from the servers. In addition, the NetServer/7000 chosen by Anadarko provided the company with 900 gigabytes of storage — much-needed capacity in an environment that has seen its data levels grow 400 percent in the past two years.

According to Stuart, the installation of the NAS was swift and uncomplicated.

Ease of set-up and minimal maintenance requirements are further advantages to NAS, said Staten. In most cases, the network doesn't have to be brought down during installation. "These devices are pretty self-sustaining. You generally just plug them in

and turn them on," he added. "They can be remotely managed via the Web, making them ideal for satellite offices or independent workgroups that can't afford a dedicated IT manager."

Potential drawbacks of NAS solutions, said Anadarko's Stuart, include network stability and performance and what he calls an "all eggs in one basket" risk.

A network using NAS "must be able to carry the throughput demand that is placed on it by large numbers of clients. In our case, the clients are moving multiple sets of 1 and 2 gigabyte files. We had to upgrade our network from 10BaseT Ethernet to a 100BaseT switched network" to handle it, he said. As for the eggs in one basket, he noted, "placing all your users' data on a central server means that if the server goes down, no one works," so it's important to research product uptime claims.

Cost considerations also came into play in choosing NAS. While the raw cost-per-megabyte of a NAS server was roughly equal to other storage options, said Stuart, the reduction in management costs and the sustained and reliable output of the server made it a very cost effective choice.

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THE INFORMATION EXPLOSION.

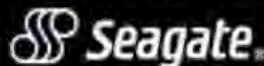
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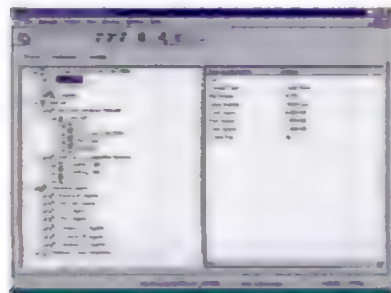


A data backup and restoral system is your network's second line of defense against data loss. It's composed of two parts: the storage media you choose and the software you use. Your media choice decisions are based on pretty obvious features, such as cost, capacity, and speed. But your software choice decisions are based on more subtle factors, such as the product's lineage, its human and program interfaces, and the resources you need to make it work.

Fortunately, this is a mature market. There are storage management solutions available for any network operating system. Here we'll focus on the most popular tape storage solutions for Windows NT and Novell NetWare — Computer Associates ARCserve, Seagate Backup Exec, and Stac Replica. All of these programs are designed to store your valuable information on removable media, and provide systems to restore data to your network.

ARCserve

Computer Associates' premier network backup program, Cheyenne ARCserve, comes with a long list of options and runs on NetWare, Windows NT, and UNIX based systems. While the standard product provides basic data backup and restore functions for your servers, the vendor also offers optional packages for a variety of network architectures. The packages include features for saving data on a main-frame, working with Hierarchical Storage Management (HSM) software, running a disaster recovery, and using autoloader or tape library devices. Such optional packages quickly add up, though. For instance, a licensed copy of ARCserve for Windows NT costs about \$700. If you add on the disaster recovery package, it costs you an additional \$400.



Overall, the basic ARCserve package is easy to install and use. Navigating the numerous menus for tasks, such as scheduling unattended backups, may complicate the lives of some administrators. But the especially powerful bells and whistles in the NT version, such as reporting and software agents, are a good trade off.

Backup Exec

Seagate's Backup Exec has an especially strong Windows NT version, too. The core program has been on the market for several years. In fact, it has been owned by at least three different companies. You even find licensed pieces of the program in Microsoft operating systems, such as Windows 9x and Windows NT.

Seagate offers several storage management programs in its product line, but Backup Exec for NetWare and Windows NT is its premier backup and restore package. Each version provides the same basic features, including disaster recovery options, multiple server and client agents, and easy-to-use menus. However, the Windows NT version's device manager, expanded hardware support, and wizards makes it the more powerful of the two. The NT version excels in another way. It's the only product mentioned here that is built around Microsoft's new COM architecture. This means that Backup Exec is 100 percent NT-compatible and ready for Windows 2000 when it arrives.

A NetWare or Windows NT single server edition costs about \$700. It comes with everything you need to backup your server and the clients attached to it. But the disaster recovery and autoloader support options will cost an extra \$500 and \$600, respectively.

Replica

Stac Replica for Windows NT and NetWare takes a different approach to storage management. It's designed to replicate and store an exact copy of your entire NetWare or Windows NT server volumes. Replica provides network administrators one of the fastest, easy to use products on the market.

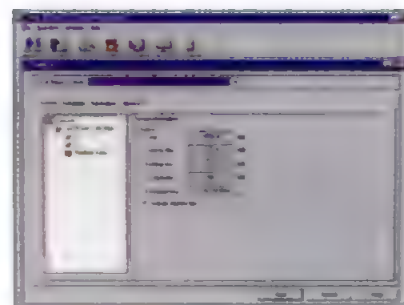
It's not a perfect product, though. Replica

By Steve Rigney

is slow at restoring data. And if you want to backup individual or changed files, keep detailed reports, or perform sophisticated tape rotations, Replica is not a good solution. But if you want a program that doesn't take a long time to learn, it's one of the best. What's more, Replica's powerful disaster recovery is a built-in feature, not an option. And its NetWare and Windows NT versions have all the same major features.

What's unique about Replica is the way it stores data to tape. Replica operates at the logical volume level. This means that it replicates the entire network volume to tape and copies each block sequentially.

Unlike file-by-file copying, Replica's Object Replication Technology doesn't open files during a backup, so you can safely replicate files that are in use. Replicating the



entire volume block by block is a faster method than file-by-file copying, too. The downside is you can't backup individual files or perform incremental backups of changed data. Replica is also limited to server protection. It doesn't provide a way to backup data on client PCs.

Replica's single server edition costs about \$700 and includes everything you need to protect your servers. Unlike ARCserve and Backup Exec, it gives you the disaster recovery option at no additional charge. A free version of the software is available without the disaster recovery option, too.

No matter which backup and restoral system you choose to buy, whatever it costs is worth it. Tape-based storage management products, such as ARCserve, Backup Exec, are cheap insurance for your data storage system.

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By Steve Rigney

The last thing you want to hear from a network administrator is, "If it's not stored on the server, it doesn't exist." While we all know that important files should always be stored on the file server, it's not always possible. Remote and travelling workers need their data wherever they are. And network users, who don't trust system security, typically keep valuable data on their own desktops.

On most networks, the common way to backup local data is to use local or server-based tape devices and programs. If you're connected to a network, software agents that come with some programs can take care of this task automatically. But many administrators find the backup agents to be unreliable and slow when running a backup to a centralized tape drive. If you're a remote worker, chances are a local tape backup device isn't available. And if you're a travelling worker, you certainly won't be carrying one. In either case, the best way to protect such user data is with an on-line solution.

On-line storage solutions include standalone network applications and Internet-based services. These provide a way for remote workers to connect to an Internet-based service or use a standard Internet account to exchange data with the corporate backup server. While on-line storage services are flexible, they can become expensive if you use them to backup all the PCs on your network. And on-line storage applications work best as a supplement to traditional backup approaches.

Piece Work

The most popular on-line storage services include @backup, Atrieve, Connected on-line Backup, and Intel on-line Backup. Standalone products include Connected Network Backup (CNB), Stac Replica Network Data Manager (NDM), and CoreData RemoteWorx.

Because the standalone applications offer the same flexibility as the services while protecting client PCs, we'll focus on them.

Both do-it-yourself and service-based

on-line storage require two pieces of software: a client agent and a storage server. Typically, the client agent is a Windows-based utility that monitors file changes and schedules backups. Some agents, such as those in CNB can even watch for an Internet connection and begin sending data whenever you go on-line. This is a great feature for mobile users who only occasionally dial into the office. The agents also compress and encrypt the data you want to backup.

The server software keeps track of all of the agents, retrieves and stores the remote data, and maintains a common database of the individual files. There is a caution, though. Server software stores data on hard disk drives. It doesn't provide any extra protection for your data. If you want extra protection, you'll need to backup the data to a tape. There's something else you should know. Most backup software applications can't backup open files, and on-line storage applications use a single database to store all of the files. This means, if you have a lot of remote and travelling users making backups of their data, the storage database file may be frequently open and in use during a network backup.

Small Favors

If you give network users a chance to backup their desktops on a LAN, most often they'll choose to protect everything. With client PCs containing several gigabytes of applications and data, this can really eat server disk space. Fortunately, all on-line storage products provide a feature called single instance storage. Here's how it works. Once the first user has backed up say Windows 98, the server can detect the OS and prevent the same files from being stored twice. Only changes to an existing file are stored. The same is true with applications and data.

To take advantage of single instance storage, you should make your first on-line backup client PC one that has all of the applications you use on your LAN. This will

allow the subsequent backups to run much faster while limiting the network and remote traffic. You need to be concerned about speed and traffic for a very good reason. It doesn't take long for a 1MB file to travel across a 10 or 100 megabyte-per-second (Mbps) Ethernet LAN, but it does over an analog or ISDN dial-up connection.

In order to limit the amount of data that travels across these slower links, all of the on-line storage products incorporate some type of delta technology. Delta technology makes sure only file changes, not the entire file, are sent over remote connections. This is an especially important feature when using large database files that are frequently updated.

While they all offer this feature, on-line storage vendors use different methods to break files into sections. For instance, CNB sends block level changes, but RemoteWorx sends byte level changes. Because there are 512 bytes in a single block, byte-level delta technology should send smaller amounts of data. Either way, both products compress and encrypt data before it's sent across the wire.

Obviously, on-line storage products and services are optimized for travelling workers with lots of data to send. However, they also benefit remote workers who only need to connect to the home office or the Internet long enough to send and receive e-mail. Brief connections and frequent disconnects aren't a problem with on-line storage products. The ones we mentioned are designed to keep track of how much data has been stored. If the backup isn't finished before you hang up your remote connection, the on-line storage software agent will place a pointer in your data and pick up where it left off the next time you connect. And some products, such as RemoteWorx, even use e-mail as the data transport. This way your data backups and restorations are sent with your normal e-mail messages. On-line storage doesn't get much easier than this.

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Hierarchical Storage Moving It from the Attic to the Road

By Stephanie Wilkinson

When the bookshelves by your desk get too crowded, what do you do? One option is to weed out the volumes you need least and store them in your attic. When the attic gets too full, you might transfer some boxes to a self-storage unit down the road.

Like overstuffed shelves, many corporate data storage devices are struggling under the weight of their contents. Data-intensive applications like enterprise-resource planning (ERP) and Y2K testing are producing masses of information, all requiring reliable storage. One way to deal with that load, savvy IT managers are finding, is to install Hierarchical Storage Management (HSM) software on their networks to manage the migration of data across several devices.

HSM software acts like a smart flood-control system. When data being generated by corporate applications threatens to engulf the primary storage device, the system kicks in, siphoning off the least-active files and funneling them into a secondary device. And when that secondary device reaches its saturation point, the software can direct files to a third location. As a general rule, the secondary and tertiary devices are composed of less-expensive media, such as rewritable optical platters or magnetic tape.

The burgeoning need for HSM technology is reflected in the rapid growth of the storage management software market. According to Carolyn DiCenzo, principal analyst at Dataquest, a market research firm in San Jose, Calif., the worldwide storage management market will more than double in size, reaching \$4.8 billion in 2002.

"Distributed backup/HSM tools are the segment of the market to be in," with their robust growth rate, she said. Leading vendors in this segment include Computer Associates Inc. of Islandia, N.Y., Veritas Software Corp., Mountain View, Calif. and Seagate Software Inc., of Scotts Valley, Calif. And while HSM has been a tool used primarily in mainframe-centric environments, DiCenzo said, "everyone else is thinking about getting into it."

Mass Migration

In many organizations, deleting idle data files isn't an option. IT managers have traditionally tried to groom their storage systems in several ways, with varying levels of success. They may try to urge users on the network to delete unnecessary files, they may try to add more capacity to their primary storage systems, or they may decide to transfer rarely-used files to archival tapes.

Enter HSM. According to Gary Ling, product manager at Veritas Software Corp., "HSM is best suited to solving data storage problems in environments where an inordinate amount of data is generated. It's also a problem solver where such large amounts of data must be accessible to users in an ongoing fashion."

"In the true HSM scenario, data is migrated from a network server to the HSM host system," he explained. "From there it is located from a hard drive to an optical library. As the optical library fills, the oldest data is relocated from the optical library to a tape library."

Trigger events, such as crossing a storage

threshold, reaching a certain file age, or a combination of both, will activate the migration process. HSM software can proceed to migrate files during idle process cycles or can be scheduled for non-peak periods. Either way, the result is that primary disk drive space is freed to hold more data.

HSM software keeps track of files so that the process of file migration is entirely transparent to network users. The newest data, or the data with the most chance of being recalled, resides on the fastest media. Older data is migrated to slower, cheaper devices. "After copying the data from the primary storage system to the secondary site, HSM software generates a placeholder file for each individual file that is migrated," Ling explained. "The placeholder file appears to the user as the normal file in their directories, as if that file were still located locally."

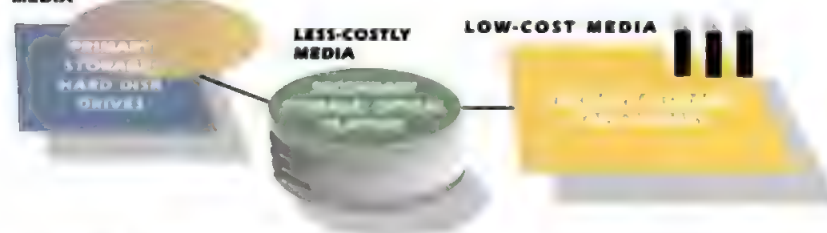
When the user attempts to open this file, the HSM application intercepts the command and goes out to the secondary storage device to retrieve it. The user may experience a brief delay, depending on the file size, as the file is copied back onto the primary storage device.

"The cost of installing HSM in corporate data environments depends to a large extent on several factors," DiCenzo said. Among them are the choice of media in the storage hierarchy, such as optical disk changers or jukeboxes and tape drives, the amount of data being managed and the cost of the HSM software itself.

With a sophisticated HSM solution in place, IT managers can focus on network performance rather than storage capacity. Since the software transparently and automatically manages the distribution of data, managers need no longer identify inactive files, manually move those files to other storage media, and maintain catalogs and backups to identify each file's location. With many files off-loaded from the server's primary disk storage, the amount of time it takes to backup mission-critical data on the server is reduced and disaster recovery time is shortened.

Finally, HSM technology preserves primary storage space, reducing the number of times a network needs to be taken off-line to add more hard disk capacity.

EXPENSIVE MEDIA



Moving Megabytes

Old data is migrated to secondary and tertiary storage devices in order to free up space on primary hard drives and ease data management

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By Alan Zeichick

Forget processor power. What really defines a high-end server solution today is storage. Well, of course you shouldn't really forget processor power. But bear in mind that it's relatively easy to add another CPU or install more memory to a server that lacks sufficient horsepower. It's also relatively painless to swap an entire server out. When it comes to storage measured in hundreds-of-gigabytes or terabytes, you're going down a road that's too narrow for a sharp U-turn.

When you're planning the buying of new storage for your network needs, too often the storage requirements are buried in the small print of a server purchase request. That's a mistake. For one thing, you're not planning on using just one brand of server for the next ten years, are you? And you don't want to be locked into a storage solution that's too closely tied to a server's proprietary features. Sure, your server manufacturer wants you to buy its homegrown or re-branded storage solution. But you don't have to. If the server maker has the best solution to your needs, that's great. If not, that's fine too.

You should ask the reseller if the storage solution you buy, whether it's manufactured or branded by server makers like Compaq, Dell, HP, or IBM, will work reliably and seamlessly with all brands of servers. That means it needs to have standard technologies, connectors, and SNMP management information bases (MIB). You want answers to questions such as, will HP NetServer's TopTools management suite fully manage a storage subsystem from IBM or from Artecon? And, can you use Dell's storage system on a Compaq ProLiant, even though it'll look funny on your rack?

The key reseller buying tip here is, you need to know all the details before you buy.

You also want to look for media flexibility, such as the ability to migrate to drives of different heights, capacities, rotation speed, and throughput. When working out the details with a reseller, insist that the drives use standard connectors. When specifying the disks themselves, look for some form of predictive failure analysis, which allows you to spot and fix problems before they become serious.

As far as the storage boxes go, you have to anticipate future needs. You may wish to chain multiple systems together, spanning RAID systems across them. Conversely, you may wish to share a storage system between multiple servers, using clustering or a Storage Area Network. And you might want to attach the storage directly to the network. The question you need answers to is, can your product accommodate those options?

If in the future you decide to upgrade your connections from SCSI to Fibre Channel, you want to know if the reseller offers a cost-effective migration. Also, it's important to learn if your system can be shared between multiple operating systems, such as NetWare, Unix, and Windows NT. While you'll live if it's restricted to supporting one OS at a time, it's something you should know beforehand.

Resellers are in the business of providing extra value for their customers. Unless you have the time and interest to immerse yourself in arcane storage technologies, you shouldn't go it alone. That's why you need to find a reseller who really knows his or her stuff — and doesn't appear to be too tightly bound to any particular manufacturer or brand. But

The Top Ten Smart Storage Questions to Ask

1. What will you be connecting your storage system up to?
2. Which bus technology will be making the connection?
3. How many storage systems will you need now and down the road?
4. What kind of drive speed and maximum capacity do you need?
5. Which operating systems will be used?
6. What high-availability features do you need and can afford?
7. Will you be outsourcing the management of your storage devices?
8. Will the storage system be backed up or replicated?
9. Do you require software-based storage management?
10. What are the changes that can be anticipated for any of the above questions?

how can you tell?

By observing if they cover the same issues and questions you just read.

Whether you go at it alone or with the assistance of a reseller, it's most important to separate your storage purchase requests from the server, networking gear, or applications you want to buy. Demand a best-of-breed solution that offers lots of flexibility, as well as room to grow. And don't discount the server manufacturer's own storage solution. Heck, it might be just what you need. But then again, it might not, and you owe it to yourself to make the best possible decision.



It's easy to predict the continuation of a trend, identifying the trend to continue is a bit more difficult. Back in 1965 one of the founders of Intel Corp., Gordon Moore, observed that microchip capacity seemed to double each year. He predicted that the power

and sophistication of microchips would continue to increase at this rate across the years, while the costs would decrease proportionately.

This became known as Moore's Law, and while the rate of capacity doubling was

extended to every 18 months, his predictions have stood the test of time. But if you apply the standards set by Moore's Law to the storage industry, you'll find it has done even better than a doubling of power for the same price every 18 months.

Because of new storage technology, we've enjoyed a compounded doubling of capacity in several forms every year for many years now. Technology features such as RAID and removable media have kept some margins in storage products, but smaller and cheaper devices will continue to be the rule.

Growing storage capacity is an easy trend to predict. The trend that's more difficult to spot is where such high-capacity storage is going to be located in future networks. Unfortunately, you can't wait for the future to unfold to make your management decisions.

A decision matrix, such as "Sizing Up Storage Options," can help. Take a look at Storage Area Network architecture. It trades co-location storage for very fast networking. And Network Attached Storage architecture accepts a marginally limited throughput on LANs as a trade off for co-location storage. And another dimension of this matrix, relatively slow LAN throughput teamed with ubiquitous storage, is wide open for development.

If you want to peek at the future of storage, check the Internet2 Distributed Storage Infrastructure (I2-DSI) initiative. Launched by IBM and led by the Innovative Computing Laboratory at the University of Tennessee,

	VERY FAST CONNECTIVITY	LAN CONNECTIVITY	WAN CONNECTIVITY
CLOSELY CONNECTED STORAGE	• Server-resident drives • Server and desktop resident tapes units	• Network Attached Storage	• Not a valid combination
REMOTELY CONNECTED STORAGE	• Storage Area Network • FA/C	• Network Attached Storage	• Internet based backup/restoration services
DISTRIBUTED STORAGE	• RAID • Server clusters	• Replication of data stores for fault tolerance and survivability	• Wide open for development

Knoxville, I2-DSI is examining how to balance distributed storage and network connectivity to take advantage of the next generation of the Internet. I2-DSI is an important part of the Internet2 project's effort to develop the new network services needed to enable collaborative study and research among universities. These services include the handling of huge volumes of data, such as audio and video content, which cannot be reliably delivered over Internet as it exists today. And it includes developing an economical infrastructure of dependable, high-performance storage

services that will take advantage of the architecture the Internet2 promises to provide.

To take advantage of the future, you'll have to study various combinations of connectivity and storage to provide the most responsive, flexible, and economical network architecture you need — short term and long term. So, as you plan your network architecture, consider the future of storage and think creatively about where information should reside. You also have to think about how the information gets to the people and places where it can really go to work.

Words and Terms You Need to Know

AIT Advanced Intelligent Tape. A magnetic tape format by Sony that uses 8mm cassettes, but is only used in specific drives.

Clustering A network architecture that interconnects servers and storage devices to improve administration, performance, reliability, and security. Parallel devices in clustered systems take over for each other in the event of a failure.

DAT Digital Audio Tape. Tape media technology designed for very high quality audio recording and data backup. DAT cartridges look like audiocassettes and are often used in mechanical auto-loaders. Typically, a DAT cartridge provides 2 gigabytes of storage. But new DAT systems have much larger capacities.

DLT Digital Linear Tape. A magnetic tape technology originally developed by Digital Equipment Corporation (DEC) and now sold by Quantum. DLT cartridges provide storage capacities from 10 to 35GB.

Fibre Channel A network transmission standard specifying signaling and data handling techniques for a variety of

connection media including coaxial cable and fiber optic cable. This standard provides high reliability in connections and assured delivery of the data at speeds up to 1 gigabit per second (gps).

Helical Scan A tape recording method that uses a spinning read/write head and diagonal tracks. It was developed for and is still used in VCRs. The fast-spinning head writes a dense magnetic image while the tape isn't subjected to fast movement, which causes stretching.

HSM Hierarchical Storage Management. A software and hardware system that moves files from hard disk to slower, less-expensive storage media based on rules and observation of file activity. Modern HSM systems move files from magnetic disk to optical disk to tape.

NAS Network attached storage is a general term for stand-alone storage devices connected directly to the local area network. These devices typically don't contain the full network operating system found in a file server, but use a microkernel designed to handle specific

data read and write functions for a variety of operating systems.

RAID is an acronym standing for array of independent drives. The RAID concept uses software or firmware to split data across several drives in order to increase the reliability of the storage. Various RAID levels signal the use of different techniques to organize the data across the drives.

SAN Storage Area Network. A network architecture and system that pools resources for centralized data storage. A SAN system may include multiple servers working against a centralized data store built with redundant hardware, such as a RAID.

SCSI Small Computer System Interface. A high-speed hardware interface used to connect multiple peripheral devices such as large hard disk, CD-ROM, and tape drives. SCSI interfaces can move data at rates ranging from 5 to 40 megabytes per second (mps).

Travan Backup tape media technology from Imation Corp. that provides higher data capacities than QIC backup tapes.

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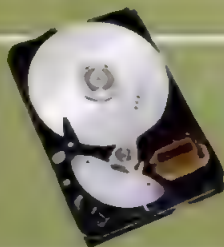
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Certificates, Keys, and Security

By Keith Pleas

The explosive growth of the Internet means that every day we entrust more and more of our corporate and individual lives—but to whom or what? We don't always know, and we can't be sure. Luckily, technologies to help solve this problem are growing as well. In particular, digital certificates and public key encryption are taking on a greater role in securing communications between individuals and organizations. In general, there are four main uses for digital certificates:

- establishing secure (SSL 3.0 or HTTPS) Web connections;
- Web client authentication;
- signing and encrypting e-mail; and
- software publishing.

Digital certificates are issued by certificate authorities (CAs), signed with private keys, and verified with public keys. Detailed treatises on encryption technology are readily available elsewhere, but the gist is that encrypting a data stream with a private key makes decrypting the stream "computationally infeasible" without knowing the private key. Many common algorithms allow decrypting of a stream by running it against the same private key; this is called symmetric encryption, a very useful tool when you need to transmit secure information over an insecure network, as in secure (HTTPS) Web connections.

Of course, symmetric encryption makes it difficult to exchange data with other parties, because they must also know the private key. The solution in this case is public key encryption, where two closely related keys are used together (they're often called a *key pair*). Typically, the public key is used to encrypt the stream, and the private key is used to decrypt the stream. You can publish the public key freely, and in fact, current directory services often come with an integrated public key infrastructure (PKI) for just this purpose. This form of encryption is also called *asymmetric* encryption. Unfortunately, asymmetric encryption is many times slower than symmetric.

In situations where two different parties want to exchange data using the vastly more efficient symmetric encryption, they typically use public key encryption first to pass a secure one-time-use symmetric key to both parties.

What exactly does "computationally infeasible" mean? What's clearly infeasible for a single individual or small organization becomes quite possible when a lot of computing power is available. In one well-known case, a group of cryptography enthusiasts used a number of computers—linked over the Internet—to decrypt a key using a brute-force approach (trying all the key possibilities). Gov-



ernments, particularly their intelligence and military departments, often have substantial computing resources available. The United States government has chosen to limit the length of the key used to encrypt data to 56 bits on exported software. This is usually called *weak* encryption, because it is possible for a determined intruder to break the key in a reasonable amount of time. Microsoft ships both a weak 40-bit and a strong 128-bit version of its Windows encryption engine: To see which is installed on your system, look at the version description in the properties dialog of Schannel.dll, located in your Windows system directory, which will show either "US and Canada" or "Export Version."

CERTIFICATE AUTHORITIES

Digital certificates are often likened to driver's licenses: Both contain important information and are created by trusted authorities. And though driver's licenses are not easy to duplicate, fraud is made even more difficult by law enforcement personnel's ability to query a DMV database to check their validity. In a similar fashion, a CA issues digital certificates, and ultimately, the CA vouches for the information contained in the certificate. This information need not be complex—often it's little more than an e-mail address—but at some point the CA is staking its reputation that steps were taken to verify that the information in the certificate is accurate. In more advanced cases, CAs will even run a Dun & Bradstreet check on an organization before giving it a certificate of a certain level (or *class*). Who are these certifying organizations? Generally, they're well-established, trusted companies like AT&T, GTE, Thawte, and VeriSign. These trusted authorities certify other organizations who might, in turn, certify further organizations. For instance, the various components of Microsoft Internet Ex-

plorer (IE) 4.0 are signed by Microsoft; RealPlayer is signed by Real Networks. And both companies get their authority from VeriSign.

Organizations that certify at the highest level of such a hierarchy are known as root CAs. Although Microsoft Certificate Server 1.0 does not officially support CA hierarchies, a subsequent white paper from Microsoft titled "Creating Certificate Hierarchies with Microsoft Certificate Server Version 1.0" describes how to use CertSrv 1.0 and certification authority hierarchies with Microsoft Exchange Server Version 5.5 Service Pack 1. Microsoft Knowledgebase Article Q186012, "Creating Certificate Hierarchies," describes



how to download this white paper (Hier3.exe) from the Microsoft Software Library.

A list of common CAs and root CAs is installed on your machine when you install a Microsoft or Netscape browser. In IE4, for example, choose "Internet Options" from the View menu, select the Content tab, and click the Authorities button to see which authorities are trusted for each of several types of operations. If you prefer, you can delete any of the CAs; if you receive a certificate that is ultimately signed by one of these CAs, however, you won't be able to verify the signer's identity. If you decide later that you'd rather have those CAs, you can reset the list by reinstalling the browser.

In theory, *any* organization can be a root CA. All that's required is for the CA to "self-sign" its certificate, and for recipients to accept the self-signed certificate. The problem is getting other people to take you seriously. Users inside your organization might be willing to trust the company, but external users (Web site visitors, for example) may well be more skeptical. Also, it's relatively straightforward for an organization to become a root CA for its internal users, either by modifying the installed list of CAs (using IE Administration Kit) or by instructing users to download the certificate from a secure internal site. Obviously, neither of these options is ideal if the certificates signed by the root CA are for use outside the organization.

Why would an organization want to be a root CA? Often, it's a matter of cost. VeriSign's OnSite license, for example, is priced from \$4,000 for up to 500 users to \$38,000 for up to 10,000 users (higher-volume licenses are also available). But an organization installing Certificate Server 1.0—which comes free with Windows NT Option Pack—pays nothing to issue client certificates. CertSrv 1.0 runs as a service under Windows NT, has no direct user interface, and works with both Microsoft and non-Microsoft browsers and Web servers. It uses Cryptographic Service Providers (CSPs) and the CryptoAPI under the hood and is accessed through several programmable objects and command-line utilities. Certificates can also be requested through included ASP pages, which in turn call those objects. Configuring CertSrv 1.0 can be confusing, but the MSDN article at <http://premium.microsoft.com/msdn/library/partbook/mts/html/secureencryptedcommunication.htm> has detailed steps for installing the product, creating a root certificate, and generating server and client certificates. Microsoft Windows 2000 will

ship with an integrated public key infrastructure and CertSrv 2.0, which will have a more complete user interface, built-in support for CA hierarchies, and additional capabilities such as a time-stamping server.

DIGITAL CERTIFICATES

The most common form of digital certificates are signature certificates, which contain some base information (typically name, organization, and location, and often e-mail address), a public key, and a digital signature. The public key is used to verify the signature, and the signature is used to verify that the certificate is valid and has not been altered. Another common type of digital certificate is the key exchange certificate, which is used to encrypt information sent to another party. For instance, a CA key exchange certificate is used by clients to encrypt information sent to the CA.

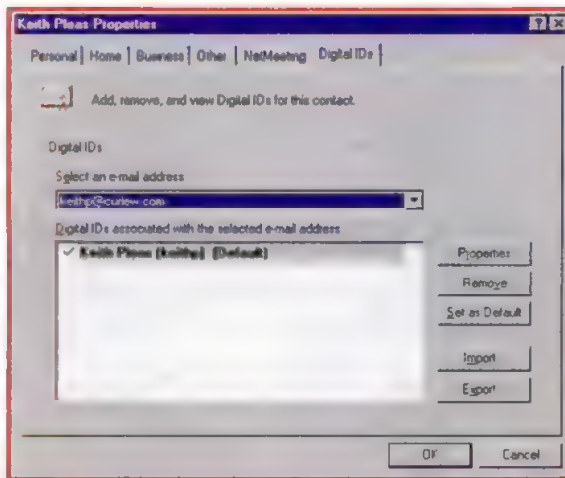


FIGURE 1: You can distribute your certificates through a variety of mechanisms, including Vcards.

When you request a signature certificate, a public/private key pair is generated (this can happen on the client/subscriber end or on the server) and the base information is sent to the CA. Note that each certificate-request generates a new key pair: Any existing keys are not used as this would be a potentially serious security flaw. The CA then generates the certificate, signs the public key (with the CA's private key), and sends it back to the requester (and optionally to a distribution system or repository).

You can distribute certificates through a variety of mechanisms: a directory server, e-mail, or mechanisms like VCards (see Fig-

ure 1). There are a variety of formats for certificates, but the X.509 Version 3 specification, originally published as part of the X.500 Directory recommendations, is currently the industry standard. X.509 certificates contain well-known fields as well as extension fields for storing additional data. The well-known fields are based on the LDAP naming convention, and they include:

- C—country (two-letter code)
- S—state or province (not abbreviated)
- L—locality (typically the city)
- O—organization (legal name)
- OU—organization unit
- CN—common name
- E—e-mail address

You can list your installed certificates using the command-line Certmgr.exe utility that comes with the Windows Platform SDK, but first you have to know the name of the "store" where they are located. A system can have any number of stores (certificates might be stored individually in files, for example), but all systems will have a root store. To list the certificates in your root store, use the command `certmgr -s root`.

The list you get should include the CA certificates that appeared in IE4's Authorities dialog described earlier. Certmgr is a much handier tool than the UI method, though, because you can also use it to add and delete certificates or export them to other stores (including files). If you have more than a single certificate (which is likely), the output will quickly scroll off the screen. You can control this by piping the output through the DOS more command or by redirecting it to a text file.

SECURE WEB SERVICES

Both Web servers and browsers use certificates. The browser presents client certificates to Web servers to authenticate users, a more secure mechanism than the traditional user/password methods, because it typically requires the client both to have a certificate *and* to enter the password protecting the private key when requested. Not only does this make impersonating other users more difficult, it can also limit clients to specific machines on which the certificates are installed.

Once Microsoft Internet Information Server (IIS) 4.0 authenticates a visitor using a certificate, the server can map the client certificate to a specific Windows NT user account using IIS's Certificate Mapping facility. IIS also allows script code in ASP to read the contents

of the presented certificate and take specific actions. The MSDN article mentioned above describes this process in greater detail.

That takes care of authenticating the client, but what about the Web server? Two related issues—authenticating servers and enabling secure communications between browsers and servers—can be addressed by server certificates. Authenticating a server prevents malicious parties from impersonating—or *spoofing*—another site. And once a Web server has a certificate, it can be used with Secure Sockets Layer 3.0 (SSL) for secure communications. If you've ever used an HTTPS (the S stands for *secure*) connection to a Web server to transmit sensitive information such as credit card data, you've used SSL 3.0. Servers can also be configured to require an HTTPS connection (using HTTP results in the HTTP message "Error 403.4 Forbidden: SSL required") and, optionally, to require user certificates.

Web server security doesn't come for free, however. First, the cost of a commercial certificate can range from \$400 on up depending on how you use it. Also, data encryption can be extremely processor intensive (the recent introduction of hardware-acceleration extensions for offloading processing can be particularly useful for SSL). Though it does not address the processing issue, CertSrv 1.0 can generate Web server certificates. The same MSDN article also describes in detail the process of configuring an IIS Web site to use a server certificate generated by CertSrv 1.0 for enabling SSL.

SECURING E-MAIL

You can enhance your e-mail with certificates in a number of ways. First, signing an e-mail message with a certificate gives recipients assurance that you are indeed who you say you are. This is important, because SMTP—the protocol used to send the majority of e-mail through the Internet—simply passes on whatever address the sender specifies (a fact that "spammers" use to their advantage). Closely related is the ability to verify that a message has not been altered somewhere along the line. Signing a message can also have legal or contractual implications: A valid certificate makes it difficult for the sender to "repudiate" a message (that is, to claim falsely that he did not send it).

The process for signing messages is the same regardless of which e-mail client is used. The first step is to calculate a *hash* value for the message content. The hash is signed with the sender's private key and the signature is attached to the message along with the sender's certificate. The recipient first uses the sender's public key (which comes with the certificate)

to verify the certificate, then calculates the same hash value for the message content and compares it with the attached value. Matching values prove the message content was not altered.

Certificates also provide the ability to encrypt messages—the inverse of the process just described. To hide the contents of an outgoing message, you encrypt it with the recipient's *public* key. At that point, the only way to decode the message is by using the recipient's *private* key, which, presumably only the recipient has. An ironic twist to this is that the sender can't read the message archived in his own Sent Items folder.

CLIENTS

Of course, each mail client sends and receives signed mail somewhat differently. Microsoft Outlook, for example, relies heavily on Exchange for securing messages and uses software from Entrust Technologies. The corresponding Message Class for signed mail is IPM.Note.SMIME instead of (typically) just IPM.Note. Outlook Express is better able to deal with S/MIME attachments and certi-

want to use. If you don't already have a signature certificate, the dialog contains a link to a page on Microsoft's Web site that tells you how to obtain one. You can get a limited free certificate from either VeriSign (www.verisign.com) or Thawte (www.thawte.com). The process is straightforward: The certificate is returned as an S/MIME attachment to a confirmation Web page. You can also use CertSrv 1.0 to generate any type of certificate. Successfully installed signature certificates are commonly stored in the "my" store and can be listed using the command `certmgr -s my`.

You can also delete certificates from a store. The interface for doing this varies by tool (some don't even support it), but you can also use commands like these:

```
certmgr -del -s my -all
certmgr -del -s my -c -n "Keith Pleas
(keithp)"
```

The first command deletes all the certificates in the "my" store. The second deletes only a single certificate with the specified name.

Once you have a valid signature certificate, you can open the Options dialog from the Tools menu, select the Security tab, and turn on "Digitally sign all outgoing messages." Or, if you prefer, you can selectively sign a particular message by selecting "Digitally Sign" from the Tools menu of the message editor or by clicking on the equivalent toolbar button. Note: If you wish to receive signed e-mail, your mail server must also be able to understand S/MIME attachments. If you're using Exchange, you need to turn on "Clients support S/MIME signatures" in the Internet Mail tab of the properties for the "Internet Mail Service" connection.

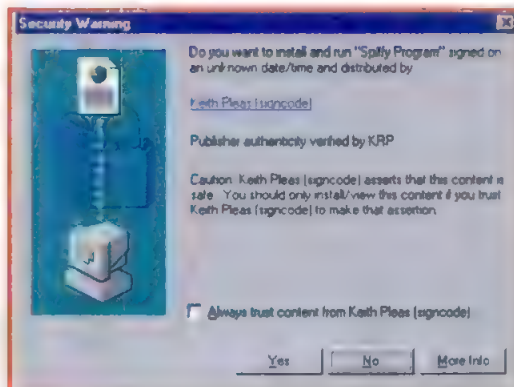


FIGURE 2: You can use certificates to sign published software for distribution through the Web.

ates. For instance, Outlook Express stores the certificates it receives from other individuals in the Addressbook store and makes it easy to access these certificates to encrypt outgoing messages. You can list these certificates using `certmgr -s addressbook`.

To sign outgoing messages using Outlook Express (and Outlook 98 as well), first you have to associate your mail account with a corresponding signature certificate. You do this by opening the Accounts dialog from the Tools menu, choosing the Mail tab, and configuring either a new or existing account. To sign messages, open the Properties dialog for that account, select the Security tab, enable the option to "Use a digital ID when sending secure messages," and click the Digital ID button to choose which ID (certificate) you

SOFTWARE PUBLISHING

You can also use certificates to sign published software packages for distribution through the Web. As you might expect (considering the potential for liability), a commercial certificate for doing this can be expensive. Another option, of course, is to use CertSrv 1.0, which is likely to be a much more cost-effective solution if the package will be distributed internally. From experience, it is much simpler to use file-based certificates and private keys than to use them in other storage locations. Of course, putting your private key in a file has important security ramifications. On the other hand, doing so also facilitates backing up the certificate and moving it to other machines—handy, because a damaged or lost private key cannot possibly be recreated. You

can also export certificates from a store to a file. The following command exports the certificate named *signcode*—actually, it exports the complete chain of certificates including CA certificates—to a file:

```
certmgr -put -7 -c -n "signcode" -s my  
TestSign.spc
```

Assuming you've got a code-signing certificate, you are now ready to sign your executable or CAB file using the *Signcode.exe* utility that comes with the Windows Platform SDK. With file-based parameters, you will need to supply filenames for SPC and PVK files. The SPC file is a PKCS7 message containing multiple certificates in a chain and the PVK file contains the private key. If you just want to experiment with this utility, make a copy of *Notepad.exe* and call it—for example—*Foo.exe*. Of course, you should not redistribute this file. Assuming all the files are in the current directory, then, enter:

```
signcode foo.exe -spc testsign.spc -v  
testsign.pvk -n "Spiffy Program"
```

where the *-n* parameter is used to specify a program name to appear in the certificate di-



alog. You should receive a confirmation that the file was signed, but not time-stamped. Time-stamping lets a software publisher specify that a particular program is "valid" even after the certificate used to sign the program is no longer valid. VeriSign operates a time-stamping server for its customer, but *CertSrv 1.0* does not include this service (it will be in *CertSrv 2.0*). If the certificate and private key are in a system store, use a command like:

```
signcode foo.exe -cn "signcode" -n  
"Spiffy Program"
```

To see the trust dialog that users will see when they attempt to download and install your program, use *Chktrust.exe*, another SDK utility. The command *chktrust foo.exe* should produce a dialog similar to that in Figure 2. This dialog gives your users the option to install and run your program and to trust all content published using the same certificate. Choosing this option lets users install

and run other programs you publish without seeing this dialog again.

NOT JUST MICROSOFT

We've seen how digital certificates can contribute to secure Web connections and e-mail communication, and how software publishers can use them to give users additional confidence in the products they distribute over the Web. Although most of the examples have focused on specific Microsoft products, it's important to realize this isn't just a Microsoft—or even Windows—technology. New security products are continually being released, though you might want to wait until they become established as standards. Smart cards, for example, offer greater security by requiring both the physical card and (optionally) a password. Unfortunately, each smart card vendor has created its own CSP that works only with its hardware, effectively limiting portability. So, though today's digital-certificate technology is more appropriate for business and technically sophisticated users, new client tools and emerging directory services will eventually make it easier for all users to exchange secure data. **PC**

Keith Pleas is an independant consultant and a frequent contributor to PC Magazine.

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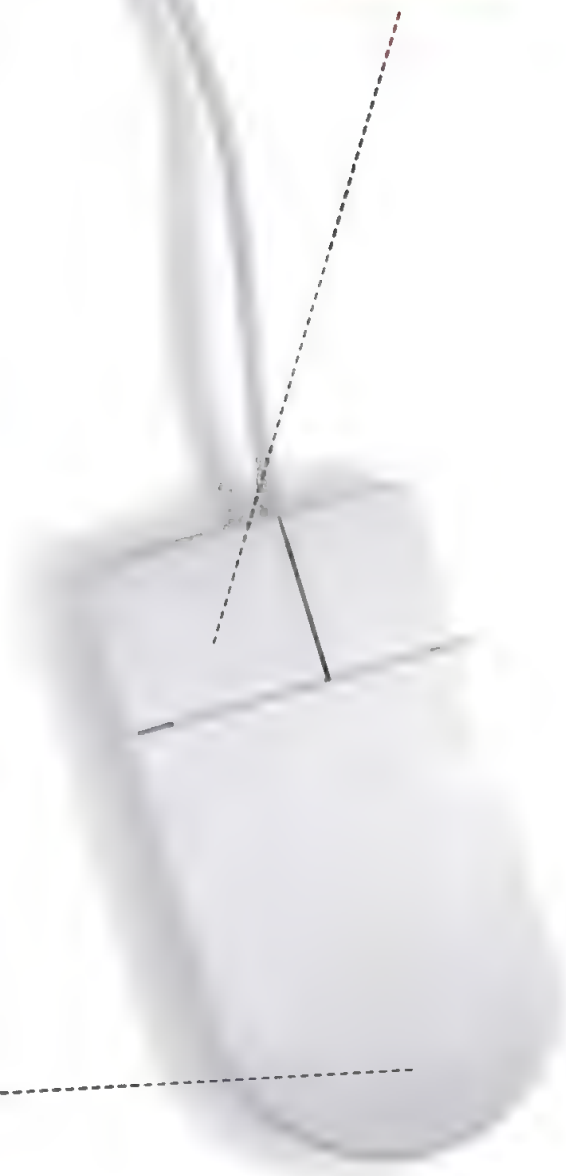
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350/Pii 32MB 6.4GB 24X	1358.69
350/Pii 64MB 10GB 10/100	1538.04
400 Celeron 64MB 6.4GB 10/100	1255.43
400 Celeron 64MB 6.4GB Win 95	1179.35
400/Pii 32MB 6.4GB	1298.87
400/Pii 64MB 6.4GB 24X 10/100	1629.43
400/Pii 64MB 4.3GB 24X 10/100	1937.42
450/Pii 64MB 10GB 10/100	1858.69
Deskpro EN Series mini-towers	
300 Celeron 32MB 3.2GB 32X	998.46
333 Celeron 32MB 6.4GB 32X	1135.86
333 Celeron 32MB 6.4GB 32X 10/100	1211.96
333/Pii 32MB 6.4GB 24X 10/100	1385.87
350/Pii 32MB 6.4GB 24X 10/100	1478.26
350/Pii 64MB 4.3GB 24X 10/100	1858.45
400/Pii 64MB 9.1GB 24X 10/100	2211.98
450/Pii 64MB 6.4GB 32X 10/100	1771.79
450/Pii 64MB 9.1GB 32X 10/100	2331.52
Presario desktops	
Cyrix 333 MMX 32MB 4GB 32X 56K	596.00
400 AMD 128MB 12GB DVD	
56K 100MB Zip	1296.00
450/Pii 128MB 19GB DVD	
1.5Mbps digital modem	1996.00

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PC 300GL Series desktops	
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350/Pii 32MB 3.2GB	1015.99
400/Pii 64MB 6.4GB NT	1249.05
450/Pii 64MB 6.4GB NT	1579.34
PC 300GL SPS mini-towers	
366 Celeron 32MB 4.2GB 10/100 MS Office	1198.67
350/Pii 64MB 8.4GB 10/100 MS Office	1322.79
400/Pii 64MB 8.4GB 10/100 MS Office	1431.84
400/Pii 64MB 8.4GB 56K MS Office	1418.37
450/Pii 64MB 12.8GB 56K MS Office	1655.52
450/Pii 128MB 12.8GB 56K MS Office	1746.94
PC 300PL Series desktops	
350/Pii 64MB 6.4GB 32X 10/100 NT	1523.05
350/Pii 32MB 4.2GB 10/100 Win 98	1197.88
400/Pii 64MB 6.4GB 32X 10/100 NT	1569.62
450/Pii 64MB 6.4GB 32X NT	1738.4
PC 300GL Series mini-towers	
333 Celeron 32MB 3.2GB Win 98	918.57
350/Pii 64MB 6.4GB 32X NT	1352.36
400/Pii 64MB 6.4GB 32X NT	1373.12
PC 300PL Series mini-towers	
350/Pii 64MB 4.2GB 32X 10/100 NT	1479.23
400/Pii 64MB 6.4GB 32X 10/100 NT	1655.52
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400/Pii 64MB 8GB 32X	1382.30
450/Pii 64MB 8GB 32X	1644.51
HP VE Series desktops	
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400/Pii 32MB 3.2GB	1191.04
HP VE Series mini-towers	
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HP VL Series desktops	
350/Pii 64MB 4.3GB 10/100	1438.56
450/Pii 64MB 10.1GB 32X 10/100	2077.34
HP VL Series mini-towers	
350/Pii 64MB 4.3GB 10/100	1488.35
400/Pii 64MB 10.1GB 32X 10/100	1662.97
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110CT 233MMX 32MB 4.3GB Win 98	1696.68
Latitude & Satellite Pro notebooks	
2530CDS 300MMX 32MB 4.3GB 13" DS	1378.48
4010CDS 266/Pii 32MB	
4.1GB 12.1" DS 24X	1248.58
4010CDT 266/Pii 32MB	
4.1GB 12.1" AM 24X	1098.88
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6.4GB 13.3" AM 24X	2338.46
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4060CDT 333/Pii 64MB 4.3GB 13.3" AM	2358.48
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8000 366/Pii 64MB 8.1GB 24X 13.3" AM	3688.98
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E360 333/Pii 64MB 6.4GB 13.3" AM 95	2458.78
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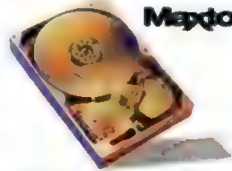
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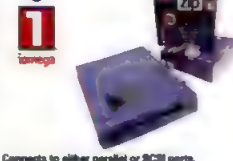
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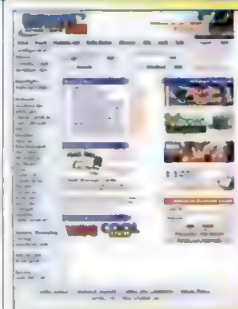
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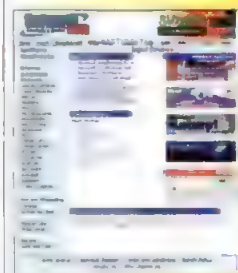
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- 24X CD-ROM
- 13.3" Active Matrix Display
- 56Kbps modem

Price Drop!
\$2,399
#37261

Order#	Model	Pentium processor	RAM	HD	CD	Display	Modem	Price
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#43475	8000	366 PII MMX	64	8.1GB 24X	13.3" TFT	—	—	\$3,899
#43474	8000	366 PII MMX	128	8.1GB DVD	14.1" TFT	—	—	\$4,499
Portege Series								
#39052	3010CT	266 MMX	32	4.3GB	—	10.4" TFT	56K	\$1,699
#43512	7020CT	366 PII MMX	64	6.4GB	—	13.3" TFT	56K	\$3,599
Satellite Series								
#43523	4030CDT	300 Celeron	64	4.3GB 24X	13.3" TFT	56K	—	\$1,999
#37261	4020CDT	300 PII MMX	64	6.4GB 24X	13.3" TFT	56K	—	\$2,399
#43517	4080XCDT	366 PII MMX	64	6.4GB 24X	14.1" TFT	56K	—	\$3,199
Libretto								
#39002	110CT	233 MMX	32	4.3GB	—	7.1" TFT	—	\$1,097

IBM ThinkPad 390

233MHz Pentium processor w/MMX technology 32MB
3.2GB HD 24X CD-ROM
12.1" TFT display
56Kbps Modem

\$1,549**
#37639

ThinkPad 380								
#36175	TP380Z	233 PII MMX	32	4.0GB 24X	13.3" TFT	—	—	\$1,879
#35180*	TP380Z	300 PII MMX	32	4.0GB 24X	13.3" TFT	—	—	\$2,299
ThinkPad 560								
#35329*	TP560Z	233 PII MMX	32	4GB	—	12.1" TFT	56K	\$2,099
#35338*	TP560Z	300 PII MMX	64	6.4GB	—	12.1" TFT	56K	\$2,549
ThinkPad 600								
#42420	TP600	300 PII MMX	32	4.0GB 24X	13.3" TFT	56K	—	\$2,799
#42422	TP600E	366 PII MMX	64	6.4GB 24X	13.3" TFT	56K	—	\$3,999
#42420	TP600E	366 PII MMX	64	6.4GB DVD	13.3" TFT	56K	—	\$4,649
ThinkPad 770								
#42437	TP770Z	366 PII MMX	128	14.1GB DVD	13.3" TFT	56K	—	\$4,749
#42441	TP770Z	366 PII MMX	128	14.1GB DVD	14.1" TFT	56K	—	\$4,999
ThinkPad 390								
#38180*	TP390	233 PII MMX	32	3.2GB 24X	14.1" TFT	56K	—	\$1,749
#38171*	TP390	266 PII MMX	64	4.3GB 24X	14.1" TFT	56K	—	\$2,099

*Windows 95 **After \$100 mfr. mail-in rebate.
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56Kbps Modem
MS Office 97 SBE V2 (included)

Starting at **\$2,239**
#42937

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Presario SMB									
#42937	122	266 MPH MMX	32	4.0GB 24X	12.1" TFT	56K	Win 95		\$2,239
#42975	144	333 MPH MMX	64	4.0GB 24X	13.3" TFT	56K	Win 95		\$2,829
#42978	162	366 MPH MMX	32	6.4GB 24X	14.1" TFT	56K	Win 95		\$3,279
Armada 1750 Series									
#43112	1750	300 PII MMX	64	4.0GB 24X	13.3" TFT	56K	Win 95		\$2,559
#43138	1750	333 PII MMX	64	6.4GB 24X	13.3" TFT	56K	Win 95		\$2,949
#43145	1750	366 PII MMX	64	6.4GB 24X	14.1" TFT	56K	Win 95		\$3,539
New Armada 7800 Series									
#35460	7800	300 PII MMX	64	8.0GB DVD	14.1" TFT	—	Win 95		\$3,599
#43316	7800	366 PII MMX	64	14GB DVD	14.1" TFT	56K	Win 95		\$4,649
Armada 3500 Series									
#43168	3500	333 PII MMX	32	4.1GB	—	12.1" TFT	—	Win 95	\$2,899
#43181	3500	366 PII MMX	64	6.4GB	—	13.3" TFT	—	Win 95	\$3,579

COMPAQ Presario 1255

333MHz AMD-K6-2 Enhanced Processor

32MB RAM 4GB HD 12.1" HPA Display
56Kbps Modem 24X CD-ROM Windows 95

\$1,399
#40901

Order#	Model	Processor	RAM	HD	CD	Display	Modem	O/S	Price
#40901	1255	333 AMD-K6-2	32	4.0GB 24X	12.1" TFT	56K	Win 95		\$1,399
#42171	1820	300 PII	64	6.4GB 24X DVD	13.3" TFT	56K	Win 95		\$2,799
#44016	1270	350 AMD-K6-2	32	4.3GB 24X	12.1" TFT	56K	Win 95		\$1,699
#44112	1670	350 AMD-K6-2	64	4.3GB 24X	13.3" TFT	56K	Win 95		\$1,999
#44117	1675	380 AMD-K6-2	64	6.4GB 24X DVD	14.1" TFT	56K	Win 95		\$2,399

SONY PCG F150

300MHz Pentium II processor w/MMX technology
32MB RAM exp. to 192MB
4.3GB hard drive
V90 Modem
24X CD-ROM
Win 98
13" HPA Display

\$1,699
#42502

Order#	Model	Processor	RAM	HD	CD	Display	Modem	O/S	Price
#42502	PCGF150	300 PII MMX	32	4.3GB 24X	13" HPA	V90	Win 98		\$1,699
#42512	PCGF160	300 PII MMX	64	4.3GB 24X	14.1" TFT	V90	Win 98		\$1,999
#42537	PCGF180	333 PII MMX	64	4.3GB DVD	14.1" TFT	V90	Win 98		\$2,099
#42538	PCGF180	366 PII MMX	64	6.4GB DVD	13.3" TFT	V90	Win 98		\$2,099
#42548	PCGF190	366 PII MMX	64	6.4GB DVD	14.1" TFT	V90	Win 98		\$3,299
#42550	PCG605TS	300 PII MMX	64	4.3GB	—	10.4" TFT	V90	Win 98	\$1,999
#42560	PCG605TX	300 PII MMX	64	6.4GB	—	10.4" TFT	V90	Win 98	\$2,099

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366 MHz Celeron Processor
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56K Modem
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#42732

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Order#	Model	Processor	RAM	HD	CD	Modem	Form	System	Price
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#38046	330	450 PII MMX	64	10GB DVD	56K	T/D	Win 98		\$1,599
Desktop EP Series									
#42176	4300	400 Celeron MMX	32	4.3GB	—	—	T/D	Win 95	\$950
#42177	10000CDS	400 Celeron MMX	64	6.4GB	—	—	T/D	Win 95	\$1,110
#36296	4300	350 PII MMX	64	4.3GB	—	—	T/D	Win 95	\$1,120
#36314	10000CDS	400 PII MMX	64	10.0GB 32X	—	—	T/D	Win 95	\$1,470
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32MB RAM 32X CD
4GB hard drive
56Kbps modem
Windows 98

\$699
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Order#	Model	Processor	RAM	HD	CD	Modem	Form	System	Price
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#40873	5184	380 AMD-K6-2	64MB	8GB 32X	56K	MT	Win 98		\$699
#40884	5240*	400 AMD-K6-2	64MB	10GB 40X	56K	MT	Win 98		\$699
#41113	5280	450 AMD-K6-2	64MB	12GB 40X	1.5bps	MT	Win 98		\$1,299
#40895	5670	450 PII MMX	128MB	19GB DVD	1.5bps	MT	Win 98		\$1,699

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K56flex V.90 upgradeable
Windows 98

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#41175

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Order#	Model	Processor	RAM	HD	CD	Modem	O/S	Price
#41175	4450	366 Celeron	64MB	8.4GB 32X	56K	Win 98		\$799
#41284	6460	400 Celeron	96MB	9.6GB 32X	56K	Win 98		\$1,099
#41283	6470Z	400 PII MMX	96MB	12.7GB 32X	56K	Win 98		\$1,399
#42080	8490	500 PII MMX	128MB	19GB DVD	56K	Win 98		\$2,499

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350 to 450MHz Pentium II processor w/MMX technology or 333 to 366MHz Celeron processor
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4.2GB hard drive
Monitor sold separately

Starting at **\$749**
#42122

Order#	Model	Processor	RAM	HD	CD	OS	Form	Price
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#42123	628732U	366 Celeron	32MB	4.2GB	—	W98	MT	\$769
#42410	6275H1U	333 Celeron	32MB	4.2GB	—	W98	DT	\$779
#42409	6275G3U	366 Celeron	32MB	4.2GB	—	W98	DT	\$849
#42133	628241U	350 PII	32MB	4.2GB	—	W98	MJ	\$999
#42395	6275B9U	350 PII	32MB	4.2GB	—	W98	DT	\$1,049
#42396	6275F1U	366 Celeron	32MB	4.2GB	32X	W98	DT	\$1,099
#42137	628761U	400 PII	32MB	4.2GB	—	W98	MT	\$1,099
#42392	6275B4U	350 PII	64MB	4.2GB	—	NT	DT	\$1,179
#42397	6275M2U	400 PII	32MB	4.2GB	—	W98	DT	\$1,179
#42394	6275B7U	350 PII	32MB	4.2GB	32X	W98	DT	\$1,199
#42411	6275G1U	366 Celeron	64MB	8.4GB	32X	W98	MT	\$1,229
#42139	628769U	400 PII	64MB	8.4GB	32X	NT	MT	\$1,479
#42140	628785U	450 PII	64MB	8.4GB	32X	W98	MT	\$1,499
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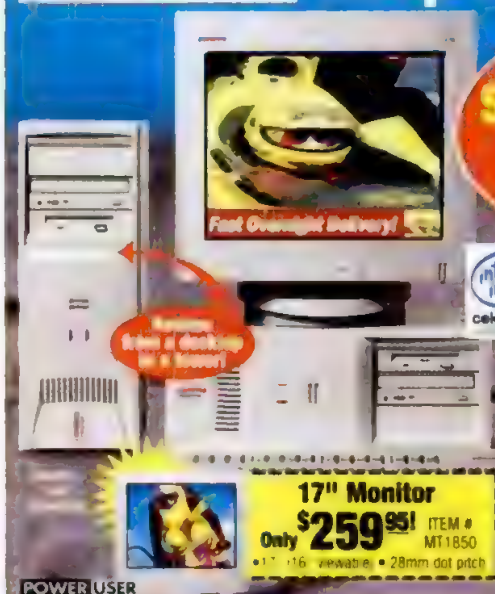
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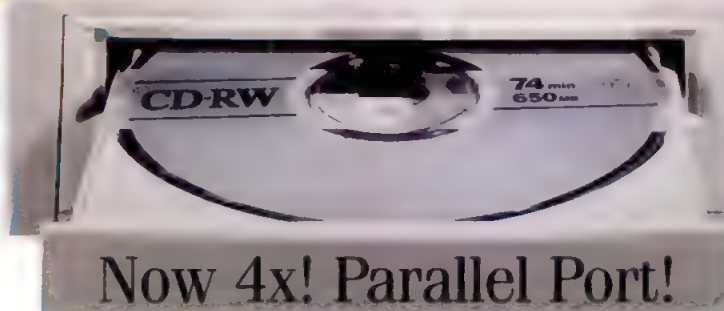
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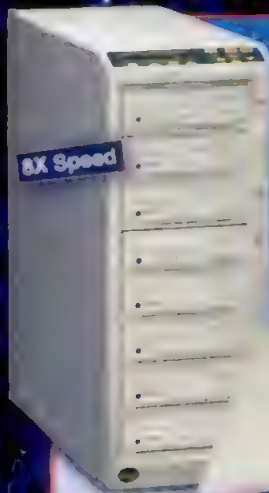
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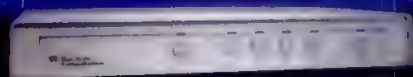
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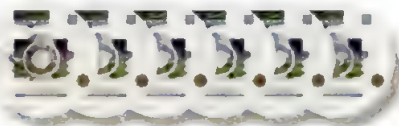
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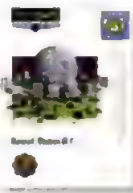
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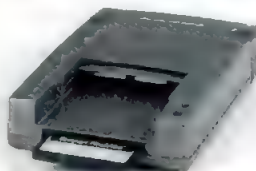
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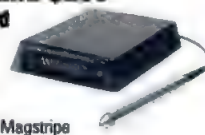
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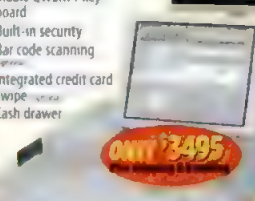
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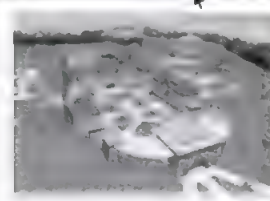
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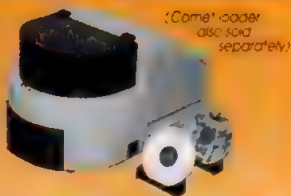
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may be sitting right in front of you. Nothing beats asking living relatives about events in their lives, and the stories they share can be a joy recorded for all generations. All of these programs provide places to record stories, facts, and events.

Proving that a particular event took place and recording the places you've looked for information are known as *sourcing*, a necessary evil if you want the job done right. As you gather information, jot down who told you what, when they told you, and where each piece of information came from.

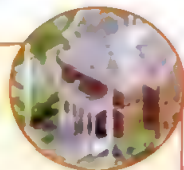
Researching the past is definitely challenging, but it can also be quite rewarding—especially if you trace part of your history to an important event or well-known person.

THE MARKET

Take note of the fact that three of the four programs reviewed here are produced by different divisions of the same company, The Learning Company (which, coincidentally, is in the process of being acquired by Mattel). The rationale is that each program targets a different market: Mindscape's Family Tree Creator is aimed at beginners, Broderbund's Family Tree Maker is for the mainstream market, and Palladium's Ultimate Family Tree is for more experienced users. Generations Grande Suite, the fourth program we reviewed, is from Sierra Home. Look for the program that best fits your needs, and happy researching!

SIMCITY 3000

Take the reins as mayor of the metropolis in this long-awaited sequel. *Page 270.*



GENEALOGY SOFTWARE

Chart Your Past

By Laura Cox

So you're finally going to commit to recording your family history. Now what? Although you'll need to do a lot of leg work to collect the facts and dates of your family's history, genealogy software can simplify and streamline the process. The four packages we review here—Family Tree Creator Deluxe; Family Tree Maker Deluxe, Version 6; Generations Grande Suite 5.2; and Ultimate Family Tree Platinum—contain powerful database engines to help you store, organize, link, and search

the history of your family.

In addition to the database aspects, genealogy programs act as graphics utilities, with tools for generating dozens of useful charts and reports. They're even equipped to handle your favorite pictures, video, and sound tracks. But you can't do anything without the most important ingredient of all—information. And without some basic knowledge of what's involved, your task can be more frustrating than fun.

RESEARCH

Before you begin, it's essential to know what type of informa-

tion you're looking for. Birth, marriage, and death dates are often common knowledge, but you'll need to know where these events took place. Physical attributes such as height, eye color, and hair color are interesting, and all programs provide a place for them. You can also record medical conditions, hobbies, occupations, and dozens of events. Just remember that each and every event has a person, date, and place attached.

Use information about yourself to start the family tree, then work backward in time with readily available information. All of the programs provide ways of quickly identifying missing information, which makes gathering your info that much easier.

The easiest research tool

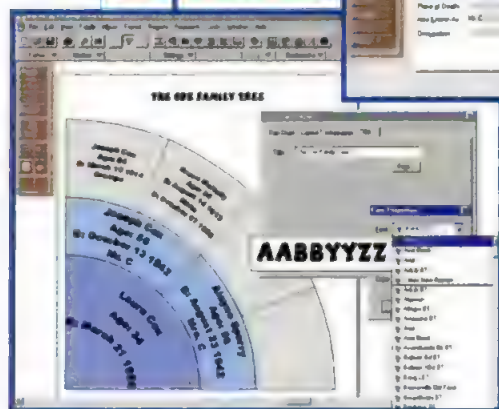
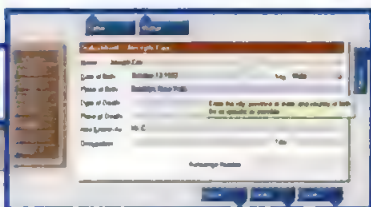
Family Tree Creator Deluxe

Family Tree Creator Deluxe is extremely intuitive and a good choice for beginners and people who want to create a quick family tree without a lot of fuss.

Each person in your family tree occupies a separate record sheet similar in look to a note card, with fields for name, date of birth, and other basic information.



The tabs that appear on-screen are constantly changing, allowing you to perform only actions that are appropriate. For example, while on someone's Events page, you can add source information by clicking on a Source tab that appears to the side of the page. On the Albums page, you can add or link images. Regardless of where you are in the program, context-sensitive help appears if the cursor is kept over a field long enough. This includes helpful tips on the type



of data to enter as well as other formatting options the package offers. You will also notice the auto-fill feature, which saves time when you are adding information previously entered.

From the program, you can connect to a Web site (www.familytreecreator.com) designed to help your research. In addition to the Internet link, Family Tree Creator provides research tools on CD-ROM. These include the Social Security Death Index, Sons of the American Revolution Patriot Index, Ancestry's Red Book (a directory of genealogical resources), and The Source: A Guide Book of American Genealogy. Though not as comprehensive as the research materials offered by Family Tree Maker, they provide a good introduction to tracking your lineage.

When you're ready to create charts and reports, you can choose from ancestor and descendant charts that display in outline, tabular, list, box, or fan format.

You can also create an album report from images linked to people's individual pages, or a register report that lets you publish reports in book format suitable for the Web. Reports are fun and easy to decorate, with a choice of box colors, fonts, borders, and styles. You can also easily add background images.

Family Tree Creator Deluxe includes Corel Photo House, which lets you scan and touch up images. It also comes with Corel Family and Friends, a calendar and address book for marking important events and tracking information.

Family Tree Maker Deluxe, Version 6



The new iteration of a perennial Broderbund bestseller, Family Tree Maker Deluxe, Version 6, makes collecting and manipulating information fun and easy. Its strength lies in the research available to the user.

Family Tree Maker's opening page is pleasantly arranged. You work from a family page that contains fields for both parents, with children listed at the bottom. As you start adding information for different members of your family, their family pages appear as tabs alongside yours.

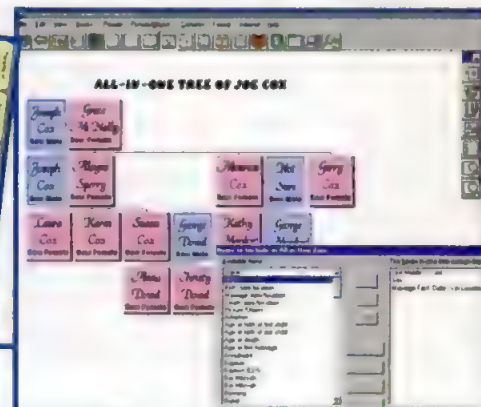
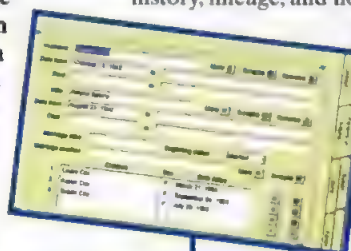
For adding more detailed information about people, Family Tree Maker offers separate areas for facts, address, medical history, lineage, and notes. Such

items as education or occupation can be added from drop-down lists, and the program indicates where you are and what you should do at the bottom of each page. Cue cards pop up when you switch to different sections of the program, and they provide helpful information, but they can get annoying after a while and can be turned off. The fast-fill feature will automatically fill in data it recognizes from similar entries.

As an example of the degree of information expected, the medical page includes height, weight, cause of death, and medical information (which is entered free-form). Although you can add any number of facts, the only specifics the form requires are a date and a comment or location.

Adding sources associated with different facts or events isn't intuitive but can be done by going to the field for which you want to add a source and selecting Source from the View menu. The package doesn't provide as much help in this area as it does in others, so you'll need to be as specific as possible about the sources you collect.

Resources to help you track down this information are the cornerstone of Family Tree Maker. In addition to the usual Social Security Death Index, Marriage Records Index, and actual family trees, the program provides a FamilyFinder Index that points you in the direction of information (dates, records, and trees) found on Family Tree Maker's Family Archive CD-ROMs. Broderbund has gone



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AFTER HOURS

beyond every other program in the market with regard to the research it makes available on CD. The CDs are priced from \$20 each to a rather pricey \$4,572 for the complete set.

Creating charts and reports is one of the program's major strengths, and there are lots of formats to choose from. In addition to the standard ancestor and pedigree charts, you can choose one of the more unusual trees such as the hourglass, or the all-in-one tree, which displays every member of your family file in one continuous tree.

Family Tree Maker's alliance to the Internet is evidenced by a separate Internet menu geared toward helping you research. Here you'll find items such as "Find individual on the Internet" and a "Go online" button that takes you directly to Web sites.

Generations Grande Suite has a more user-friendly interface and charting features, but Family Tree Maker is the program to turn to for research and information.

Generations Grande Suite 5.2

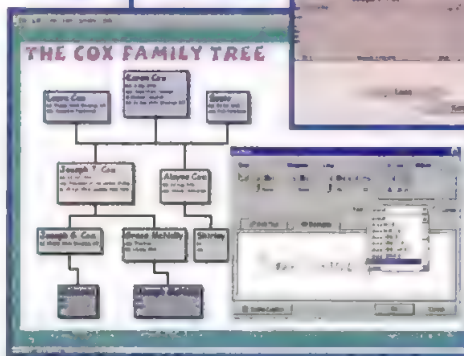
Sierra Home's Generations Grande Suite 5.2 makes entering data and creating a brand-new family file a snap. It is without a

doubt the most flexible and customizable program of the group.

When creating a family file for the first time, you're presented with a helpful dialog box that takes you to the main window of the program, which is called a *family card*. The family card is where you will do most of your navigating; it contains you and your spouse in the middle of the screen, with each of your parents listed above your names, respectively, and your children (if any) listed at the bottom. Branches connect the various boxes on-screen, making it easy to jump to, say, your mother's family card. The program makes it very clear which individual you are working on—a major improvement over Version 4.2. Adding supplementary information about a person is a matter of one mouse click from his or her family page; there are separate pages for events, facts, notes, and flags.

The ability to customize the data and the views is certainly the most notable characteristic

of the program. Adding specific facts and events for people is made easy by drop-down lists to which you can add your own unique information. Source information can be added in a similar manner, with drop-down lists and default fields that ensure the proper information is recorded.



Generations also gives you lots of flexibility in choosing how information and data are displayed on-screen, including font styles that can differ from sheet to sheet. You can even customize the colors and styles of certain items on your family card.

Creating ancestor charts and reports is done through EasyChart, the program that loads when you choose the report type

you want. The chart-design process provides lots of creative control over line colors, styles, and fonts. You can also edit the information that appears in each person's individual box. For example, you can change *Susan* to *Suzie* without affecting Susan's individual record. You're also given the ability to drag boxes around on-screen, some-

thing the other programs restrict you from doing.

Generations takes a different approach than top competitor Family Tree

Maker does when it comes to presenting research resources. Generations, like the other two programs, presents sources and starting points on its World Name Index, Historic Records, Names Glossary, and Internet links. Searches may result in a microfilm archive number or a link to more information on the Web. Be prepared to track down leads. Of course, research methodology is a matter of preference: If you want all the information on CD-ROM and are willing to pay (handsomely, in some cases), you should go with Family Tree Maker. Generations, however, offers more than enough information to springboard you into fact finding.

Generations Grande Suite 5.2 includes two additional programs: SnapShot SE, for repairing old photos and creating albums, and MasterCook Heritage Edition.

Ultimate Family Tree Platinum

Ultimate Family Tree Platinum is the most sophisticated and powerful program in this group and focuses more on collecting and manipulating data and less on decorating it.

When you first open the program, you're presented with an individual record window that contains simple, fill-in-the-blank fields for your name and

Terms of the Trade

- Ancestor report or chart—A history that starts with the individual and works backward in time.
- Descendant report or chart—A report that starts with an individual and works forward in time.
- GEDCOM—Genealogical Data Communications; a standard file format developed by LDS that lets people using different software share data.
- LDS—The Church of Jesus Christ of Latter-day Saints, which maintains a collection of both compiled and primary reference materials from all over the world. It's made available to researchers through a network of Family History Centers.
- Pedigree chart or ancestor tree—A diagram

that displays your family lines at a glance. It can have many formats, such as a fan or box.

- Primary Source—Records created at or about the time an event occurred. They are apt to be more correct than secondary records. Examples include birth certificates, wills, and deeds.

- Secondary Source—Records created after an event took place. An index to a record is an example.

- Sourcing—Recording the proof that something happened, whether it's a birth, marriage, or death. Records vary widely in their accuracy—especially when you are dealing with older, handwritten records. Recording places you've searched that contained no information is also valuable.

Nothing lasts longer.

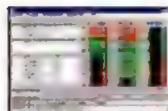


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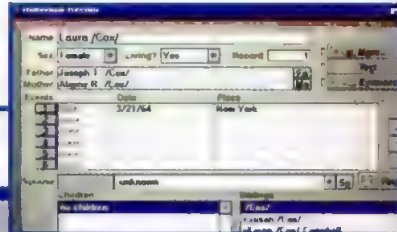
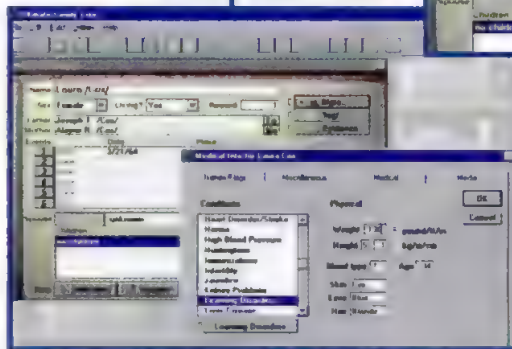
gender, as well as those of your parents, siblings, children, and spouse. You can think of your own individual record as home base; from there you can jump to immediate family members' pages by clicking on tabs that appear next to their names.

You add more specific information in sections dedicated to names and flags, medical information, and miscellaneous. Navigating is easy, and indicators at the top of each section make it obvious whom you're adding information about. Ultimate Family Tree Platinum is also the only program that lets you add a sibling from your own record.

(The other programs force you to navigate back to a parent record to add another child.)

The amount of information you collect is up to you, but the choices are enormous and could be a bit overwhelming for some. But if one of your main interests in genealogy is to chart a medical history, for example, then you'll appreciate the program's style. In addition to spaces for physical attributes such as eye color and blood type, there's an extensive drop-down list of other

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conditions to choose from, including such items as learning disorders and addictions.

Information for key events such as births and marriages is kept on the Events page for each person, and again, the program provides check

boxes and extensive drop-down lists for explaining the events and the roles people played.

Proving that particular events took place can be done from virtually anywhere in the program. The Evidence section is accessible from a person's individual page or from a specific event window. It lets you record qualifying items such as books or a birth certificate.

As expected, the search capabilities are enormous and can be used for further analysis or reporting. You can search for individuals by specific events, media links, locations, vital statistics, relationships to others, and other criteria.

When it comes to tracking down information, the program offers the Social Security Death Index, a free search from Lineages, and an index CD that catalogs church, will, and land records. This information, as well as the hyperlink to RootsWeb, provides a solid foundation for beginning your research.

Once you've gathered your data, you're ready to create your charts. Images and video and sound clips can be added to Ultimate Family Tree's multimedia library.

Of course, you can also build and decorate charts in Ultimate Family Tree, but it wasn't as much fun as with the other programs—a minor quibble in an otherwise comprehensive program.

Internet Resources

Regardless of the program you choose to help uncover your lineage, the Internet will play a big part in your search. With so much information available, it's important to know where to look. Here's an overview of some of the best genealogy sites the Web has to offer:

Those just starting out should consider purchasing a copy of Cyndi Howell's *Netting Your Ancestors: Genealogical Research on the Internet* (available at www.cyndislist.com and in-

cluded with *Generations Grande Suite 5.2*). This insightful tome guides you through the steps of online research and includes tons of useful site URLs; Cyndi's List of Genealogy Sites on the Internet is incredibly comprehensive and paramount among those sites. All of the programs we review here have top-notch Web resources associated with them. Even if you don't own a specific program, you're apt to find valuable information on its site.

Family Tree Creator Deluxe sponsors *Ancestry.com* (www.ancestry.com), a site that offers both free and subscription-based information. A subscription will cost you \$60 per year and provide you access to 800 databases, 200 million names, and countless articles; as a guest to the site, you can search selected databases and peruse tons of tips and articles.

Family Tree Maker Deluxe's *Genealogy Site* (www.familytreemaker.com) scores big with its depth and breadth of information. In addition to finding message boards, articles, and related

links, you can perform searches on almost any topic—from Civil War records to marriage licenses (individual searches average \$12). The site is also home to World Family Tree, an ambitious effort to make tens of thousands of family trees available to researchers.

Sierra Home, the force behind *Generations*, has put together a stylized, extremely helpful genealogy site (www.sierra.com/sierrahome/familytree). Its Essential Tools section offers up

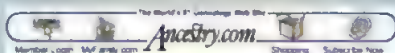
printable Family Group Sheets for recording and organizing facts and figures, the Social Security Death Index, news

from the Everton Family History Newsline, and message boards and chat rooms. Although the site

offers a subscription-based search service (\$50 per year through Everton Publishers), it also grants free access to a (normally fee-based) database each month.

The pages served up by Palladium's *Ultimate Family Tree* (www.ultree.com) are the scantest of the bunch. There is indeed a wealth of information on the site, but if you don't own a copy of *Ultimate Family Tree* you can't access most of it. Even the message boards are restricted, which is a shame, because researching your roots is all about networking.

An extensive list of links to related resources is one common element among all these sites. If you've got the time, any one of these sites can take you all over the world in search of your past.





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SIMULATION

Sim-sational

Loads of fun and as addictive as ever, the latest version of SimCity won't disappoint fans who have waited years for the upgrade. Like the previous version, SimCity 3000 lets you build your city from scratch, populating it with industry, commerce, water towers, power plants, airports, and more. The graphics are greatly improved, and the range of political choices laid at the feet of the "mayor" are much more subtle and complex.

The incentives for success are still mostly the same—keep housing away from industry, keep crime under control—but there's a lot more to keep in mind. You can make deals with neighboring cities to boost income (by selling them surplus electricity, for instance), and you can burn your city's garbage,

recycle it, or just dump it. In this incarnation, you can build on real terrain maps of Paris, San Francisco, and New York, among other cities, and build landmark structures such as the Empire State Building. You can also zoom in close enough to see architectural details on buildings and watch people strolling down the streets—especially enjoyable during a riot.

With SimCity 3000, you feel a lot more like an actual mayor, because you're constantly interacting with citizens. When you reduce spending to cut costs, for example, employees may strike. And the expanded list of ordinances includes items like annu-



pumps, lay a main, and you're good to go—no more perpetual desert conditions. But there's still no way to make an underwater tunnel; building a bridge where you want one is still bizarrely difficult, and dispatching police and firemen to an emergency still resembles playing Parcheesi.

That said, these difficulties are minor annoyances and pose no real threat to your enjoyment of the game.

SimCity 3000 is an irresistible game and a real improvement over the previous version with regard to both graphics and game play. It is worth mentioning, however, that the system recommendation of a 223-MHz Pentium MMX or better should be heeded. In fact, we found that a Pentium II system is preferable.—*Josh Levy* **PC**

Coming Up

What's in the Next Issue of *PC Magazine*

PC Magazine's 1999 Utility Guide

If you've got a problem with your PC or network, there's a tool or service that can help resolve it. In this annual guide, PC Magazine Labs will test dozens of Windows 95, 98, and NT desktop and network utilities, as well as Web-based services for troubleshooting your PC. You'll find in-depth reviews of the staples no business should be without, such as antivirus software, diagnostic tools, and file and disk maintenance utilities.

We'll also review new Web-centric utilities, including online backup services, corporate filtering and monitoring packages (for controlling which sites employees visit), Web organizers and annotators, instant-messaging utilities that help far-flung workgroups communicate online, and file-transfer programs.

Solutions

To create a state-of-the-art Web site, you need the power tools of the Web elite: JavaScript and Cascading Style Sheets. We'll show you how to use JavaScript to make your site interactive and how to use CSS to give it a polished design. Then we'll explain how to combine the technologies—creating style sheets powered by JavaScript—to tailor your site for individual users.



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AMD K6-2	380MHz	96MB	8.4GB	\$1029.99	(CTNTM38)
AMD K6-2	350MHz	128MB	10.2GB	\$1069.99	(CTNTM35)
Intel Pentium II	350MHz	64MB	6.4GB	\$1079.99	(CTNTM11)
AMD K6-2	400MHz	128MB	10.2GB	\$1129.99	(CTNTM37)
Intel Pentium II	400MHz	96MB	10.2GB	\$1299.99	(CTNTM12)
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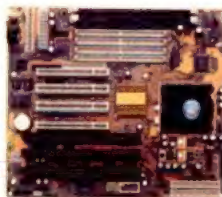
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Tiger M-571 Pictured

Tiger 571 Form Factor: AT • CPU: Socket 7 • Bus Speed: Up to 63 MHz • On Board Video: PCI 4MB • On Board Audio: YES • PCI Slots: 4 • ISA Slots: 3 • Memory: 20MM/45MM • Max Memory: 128/256 MB
Tiger 573 Form Factor: AT • CPU: Socket 7 • Bus Speed: Up to 75MHz • On Board Video: No • On Board Audio: YES • PCI Slots: 4 • ISA Slots: 2 • Memory: 20MM/45MM • Max Memory: 128/256 MB

Tiger SS7 ATX Super Socket 7

Motherboard & Case: Motherboard mounted in dual-cooling fan ATX case with 1MB Cache; 235-watt power supply, cables, manual.

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Tiger SS7 Motherboard Features At-A-Glance

Form Factor: ATX • CPU: Socket 7 • Bus Speed: Up to 100 MHz • AGP Slots: 1 • PCI Slots: 5 • ISA Slots: 2 • Memory: 3DIMM Sockets • Max Memory: 768MB

Tiger 6KE LX, 6BE+ BX AGP Slot 1

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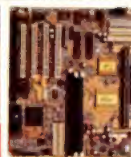
Tiger 6KE LX Motherboard Features At-A-Glance

Form Factor: ATX • CPU: Slot 1 • Bus Speed: Up to 66 MHz • PCI Slots: 4 • ISA Slots: 3 • Memory: 3 DIMM Sockets • Max Memory: 384 MB
Tiger 6BE+ BX Motherboard Features At-A-Glance
Form Factor: ATX • CPU: Slot 1 • Bus Speed: Up to 100MHz • PCI Slots: 4 • ISA Slots: 3 • Memory: 3 DIMM Sockets • Max Memory: 768 MB

Tiger 767 AT, 760 ATX Slot 1

Motherboard & Case: Motherboard mounted in dual-cooling fan case, cables & manual.

Pre-Assembled Kits: Motherboard in dual-cooling fan case; keyboard, speakers, mouse, 3D AGP video, 56KFlex faxmodem, 1.44MB floppy drive, 24X CD-ROM, Wave Table sound.



Tiger 767 Form Factor: AT • CPU: Slot 1 • Bus Speed: Up to 100 MHz • On Board Video: 8MB AGP • On Board Audio: YES • PCI Slots: 4 • ISA Slots: 1 • Memory: DIMM • Max Memory: 768 MB
Tiger 760 Form Factor: Micro ATX • CPU: Slot 1 • Bus Speed: Up to 100MHz • On Board Video: 8MB AGP • On Board Audio: YES • PCI Slots: 3 • ISA Slots: 1 • Memory: DIMM • Max Memory: 768 MB

MOTHERBOARD SPECIFICATIONS

Motherboard Design	Processors Supported	Item No	1-2 units	3+ units	Item No	1-2 units	3+ units	Item No	1-2 units	3+ units
Tiger 571 AT including Wave Table sound and PCI video	AMD Up to K6-300 & K62-266 Intel Pentium up to 233 MMX IBM/Cyrix Up to PR300	MB1-C-1B	\$75.99	\$68.99	BB1-C-1B	\$124.99	\$114.99	KT1-C-1B	\$214.99	\$197.99
Tiger 573 AT including Wave Table sound	AMD Up to K6-300 IBM/Cyrix Up to PR300; Intel Pentium up to 233 MMX	MB1-E-8A	\$39.99	\$37.99	BB1-E-8A	\$99.99	\$85.99	KT1-E-8A	\$169.99	\$159.99
Tiger SS7 Super Socket 7 1MB Cache	All AMD Up to K62-400; Intel Pentium up to 233 MMX IBM/Cyrix up to MII 350	MB1-T-7B	\$69.99	\$64.99	BB1-C-2D	\$129.99	\$119.99	KT1-E-2C	\$256.99	\$249.99
Tiger 767 AT Slot 1 with Sound & AGP video	Celeron up to 333MHz Intel Pentium II up to 500MHz	MB1-E-5A	\$83.99	\$83.99	BB1-E-5A	\$149.99	\$137.99	KT1-E-5B	\$249.99	\$229.99
Tiger 760 Micro-ATX Slot 1 w/Sound & AGP video	Celeron up to 333MHz Intel Pentium II up to 500MHz	MB1-E-6A	\$83.99	\$83.99	BB1-E-6A	\$139.99	\$128.99	KT1-E-6A	\$224.99	\$209.99
Tiger 6KE LX ATX Slot 1	Celeron up to 333MHz Intel Pentium II up to 333MHz	MB1-T-10A	\$45.99	\$35.99	BB1-T-10A	\$114.99	\$99.99			
Tiger 6BE+ BX ATX Slot 1	Celeron up to 500MHz Intel Pentium II up to 500MHz	MB1-T-9A	\$84.99	\$77.99	BB1-T-9A	\$149.99	\$139.99			

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#CP2-6X333 MII 333 CPU	\$59.99	\$56.99*

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Edited by Don Willmott

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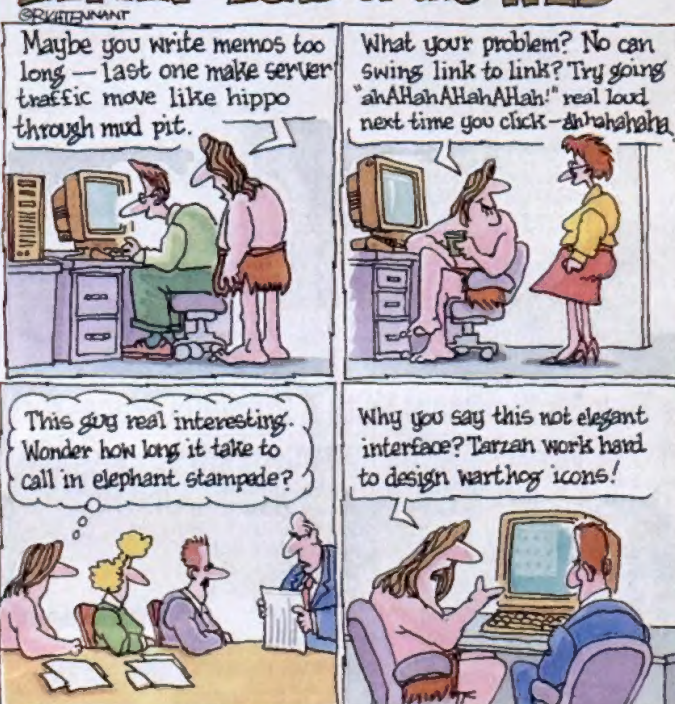
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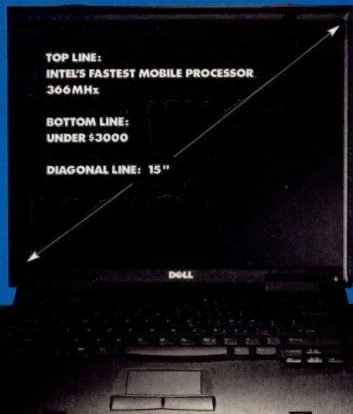
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